Bihar Rice Value Chain Analysis and Recommendations

July 2013
Executive Summary (1 of 3)

**SUPPLY-DEMAND DYNAMICS**

- While India has attained rice self-sufficiency at a national level, there are pockets of deficit including Bihar
  - India has managed to attain rice self-sufficiency (~99 million MT production in 2012 vs. ~95 million MT consumption) and amass sizeable rice stocks (~20 million MT+ in recent years)
  - Bihar remains a rice deficit state, with ~2 million MT deficit in 2012 and as high as ~4+ million MT deficit in drought years 2010 and 2011
  - Rice demand in Bihar set to grow further, with a ~20% increase by 2025, driven by population growth and meeting of latent demand

- Rice productivity improvement is an imperative to enhance food security and reduce poverty in Bihar
  - An estimated ~25% of Bihar is food insecure, and Bihar has highest poverty levels in India, with 50%+ of population below poverty line, according to latest Govt. of India Planning Commission estimates
  - Rice farming affects highest number of households in Bihar (~60% of total households)

**VALUE CHAIN & CONSTRAINTS**

- Two broad farmer segments can be distinguished on the basis of consumption patterns and landholding size (rather than on a geographical basis) – subsistence vs. surplus farmers.
  - Subsistence farmers (~4M households; 35-40% of total paddy farmers) would typically have landholdings of ~0.2-0.3 ha and incomes of ~Rs. 13,750 (~$250), while surplus farmers (~7.5M households; 60-65% of total) would have landholdings of ~0.8-1.0 ha and incomes of ~Rs. 24,750 (~$450)
  - In most districts, marginal subsistence farmers tend to be interspersed amongst small-to-medium surplus farmers
  - Key exception is in drought prone areas (~15% area), where majority of farmers are subsistence. This drought-prone sub-set of subsistence farmers has broadly same characteristics and value chain linkages as subsistence farmers generally, apart from higher risk profile and weaker input supply chain given small-scale rabi crop

- For surplus farmers, key constraints are seeds (~15% yield impact, ~50% income impact), agronomic practices (~20% yield, ~55% inc.), mechanization (~5% yield, with ~30% inc.) and inter-related set of issues around market access, milling and infrastructure (~75% inc.). Key secondary issues are fertiliser (~15% yield, ~20% inc.), irrigation (~50% yield, ~160% inc. for ~40% farmers without irrigation), post-harvest practices (~5% yield, ~20% inc.)
  - Seeds: Farmers do not receive quality seed at the right time due to quality control and distribution challenges at Bihar State Seed Corp., the dominant seed provider
  - Agronomic practices: Knowledge (due to poor quality and reach of extension services) and labour availability are key constraints
  - Mechanization/Labour: Low mechanization rates driving up costs and contributing to continuation of out-dated agronomic practices
  - Market access, milling, infrastructure: Most farmers receive ~15-20% below MSP and experience long delays in payment due to inefficient govt. procurement. Furthermore, due to inadequate milling capacity in the state (driven by massive electricity shortage), Bihar farmers pay a 5-10% price penalty vs. farmers in other states (i.e. ~15-20% discount to MSP vs. ~10-15% discount in other states)
  - Secondary constraints: Balanced fertiliser application a major issue with negligible soil testing. Irrigation is very expensive due to reliance on diesel pumps. Poor post-harvest practices and lack of storage at farm level leads to wastage.
  - Non-constraints: While usage is low, no govt. distortion in pesticides
Executive Summary (2 of 3)

• For subsistence, marginal farmers, key constraints are seeds (~20% yield impact, 80% income impact) and agronomic practices (~30% yield, 90% inc.). Secondary issues are fertiliser (~20% yield, 35% inc.) and irrigation (~50% yield, ~155% inc. for ~50% of farmers without irrigation) and post-harvest practices (~5% yield, ~20% inc.). Less of an issue are pesticides, mechanization/labour, market access (given these farmers do not sell their produce currently) and milling. Infrastructure is similarly poor as for surplus farmers, and requires significant and long-term investment from govt.

- Seeds: Availability of quality seed at the right time similarly poor for this segment, with these farmers even less educated on the benefits of newer and/or stress-tolerant varieties. For drought-prone subset, availability of Sahbhagi Dhan a particularly critical constraint
- Agronomic practices: Knowledge is the key constraint, with hardly any farmers practising line transplanting, young seedlings, single seedlings etc.; marginal farmers tend to have even less access to govt. extension services
- Secondary constraints: Lack of soil testing resulting in imbalanced fertiliser application is again an issue. For farmers with irrigation facilities, same affordability constraint as for surplus farmers, but impact on incomes more acute.
- Non-constraints: Economic case for pesticides less clear for these subsistence farmers. Labour is relatively available within the family and is not currently a constraint. Though inefficient, sufficient capacity in older village mills to mill rice for self-consumption. If these primarily subsistence farmers were to begin generating marketable surplus, basic market linkages are in place such that they would be able to sell their paddy, though they may receive slightly lower prices (~20-25% below MSP) due to less bargaining power.

• Both Central & State governments increasing agriculture spend and focused on rice productivity enhancement
  - Central govt. increasing agri. spend at ~7% CAGR (04-12), and has launched several flagship schemes to enhance cereals productivity, of which rice is a central component: National Food Security Mission (NFSM); Bringing Green Revolution to Eastern India (BGREI)
  - Bihar State Govt. planning ~Rs. 1,500 billion (~$30B) expenditure over 2012-2017 as part of State Agricultural Roadmap; anticipates ~15% to come from private sector

• While the standard, centrally-set policies are in play in Bihar (MSP, PDS, fertiliser subsidies), regulations in Bihar rice sector are relatively more open (vis-à-vis Orissa)
  - Seeds: While subsidy on HYV seeds limited to govt.-distributed seed, as in Orissa, lower subsidy rate (~25% of retail price) has enabled slightly greater private participation (though govt. still commands ~70% share of HYV market). Additionally, relatively large private-led hybrid sector (~10% of total rice area under cultivation), with generous govt. subsidy on hybrid seeds
  - Milling: Millers can freely choose to mill for the govt. (under the custom milling scheme) or the open market. The levy option has not been exercised in the recent past and is unlikely to be reinstated. Favourable subsidies are in place to promote milling capacity and technology

• However, significant constraints in market access and infrastructure
  - Market access: Govt. commits to buy all paddy at Minimum Support Price (MSP), though Bihar’s relatively new procurement system lacks both manpower and infrastructure capacity, and is poorly managed. As a result, many farmers do not receive this MSP.
  - Infrastructure: Supply of power remains a key constraint to development of milling sector and increased milling capacity
Executive Summary (3 of 3)

Based on these constraints, a number of intervention priorities emerge:

- **Seed commercialization** and agronomic practices for both segments; **mechanization** for surplus farmers
- **Fertilisers, irrigation and post-harvest practices** secondary concerns for both segments, and can be folded into broader package of practices
- Improving **farmer price realisation** through increasing **milling capacity** is more challenging, but also critical to address

Constraints should be tackled through an integrated intervention approach focused on 4 areas of (A) Seeds; (B) Mechanization; (C) Extension; (D) Farmer price realisation via milling

- Government co-operation should be facilitated through a broad-based MoU with State Govt. and an embedded Project Management Unit
- Over time, expand partnership from relatively uncontroversial issues (e.g. seed supply) to more sensitive ones

(A) **Seed commercialization** via diagnostic and subsequent assistance to make BSSC more competitive (in particular, address human resource gaps); enable private sector to play a larger role

- Conduct data-driven diagnostic in conjunction with Bihar State Seed Corporation to identify root causes of current challenges. One key gap already identified is a lack of experienced professionals among the leadership ranks of the seed corporation
- As part of diagnostic, identify areas where private sector can play larger role e.g. seed distribution via direct provision of subsidy to farmers

(B) **Increase mechanization via service provider model** in areas were CSISA is not active

- Support development of a service provider model in non-CSISA districts, whereby entrepreneurial farmers are linked to equipment manufacturers, and given training, support and access to credit so that they can purchase equipment and rent it out to others

(C) **Facilitate co-ordinated extension approach** by creating a platform for engagement for key players

- Minimise overlap (both in activities and geography) and leverage each player’s respective strengths e.g. State Govt.’s reach and funding, Jeevika’s deep community networks, Digital Green’s cost-effectiveness and sustainability

(D) **Build milling capacity to improve farmer price realisation**

- E.g. Pilot small-scale mills owned and run by Farmer Producer Organizations, who will guarantee MSP to farmers and enable farmers to capture additional value
- Work with govt. to create appropriate ecosystem for large-scale private milling e.g. stable electricity supply, access to capital etc.

If executed and scaled effectively, interventions can have a sig. income impact on ~9M farming households

- For **surplus farmers**, addressable population of ~5-6M households, with a theoretical full potential ~45% yield and ~220% income impact (add.. Rs. 18,300 / $335) on current baseline (~2.6 MT rice yield/ha; ~Rs. 8,500 / $155 income/ha); translates into on-farm stretch target of ~35% yield and ~150% income impact (add. Rs. 12,800 / $235)
- For **subsistence farmers**, addressable population of ~3.5M households, with a theoretical full potential ~60% yield and ~290% income impact (add. ~Rs. 15,000 / $275) on current baseline (~1.6 MT rice yield/ha; ~Rs. 5,100 / $95 income/ha); translates into on-farm stretch target of ~50% yield and ~200% income impact (add. Rs. 11,500 / $210)

*Integrated set of crop cultivation practices from land preparation to post-harvest management*
Agenda

Project approach

Supply-demand dynamics

Value chain & constraints

Policy & government context

Prioritized interventions
**Approach: A 3-step approach followed**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Key activities</strong></td>
<td><strong>Intervention design</strong></td>
<td><strong>Validation &amp; synthesis</strong></td>
</tr>
</tbody>
</table>
| • Understand **overall market context**  
  - Supply-demand dynamics  
  - Policy context  | • Develop interventions to address key constraints  
  • **Prioritise interventions** based on impact and ability to implement  
  - Yield and income increase  
  - # farmers impacted  
  - Feasibility  | • Test and refine intervention hypotheses with **key stakeholders**  
  - Validate interest and feasibility  
  - Refine based on feedback  |
| • **In-depth snapshot** of Bihar rice value chain  
  - Farmer behaviour and segmentation  
  - Revenue & profit build-ups  
  - Value chain inefficiencies | | |

**Key sources**  
(see next slide for detail)

- Stakeholder/expert interviews
- Fieldwork across 4 districts
- Secondary research

**Outcomes**

- **Key constraints** across rice value chain in Bihar
- Prioritized set of interventions
- Preliminary implementation plan
- Final, validated set of recommendations
# Approach: Wide range of stakeholders consulted

## Stakeholder Interviews
- **Government**
  - Director, Bihar Department of Agriculture
  - Bihar State Food and Civil Supply Corporation
  - Bihar Department of Food & Consumer Protection
  - Bihar Department of Industries
  - Bihar Department of Energy
  - Bihar Rural Livelihoods Promotion Society (Jeevika)
  - Bihar State Seed Corporation
  - Food Corporation of India
  - Chairman, Commission on Agricultural Costs & Prices (CACP)
  - Agricultural and Processed Food Products Export Development Authority (APEDA)
- **Private sector**
  - Rice Miller Associations for several states
  - Large millers (e.g. Jhunjhunwala Oil Mills, Mahajan Mills etc.)
  - Input providers (e.g. Bayer, Syngenta, Pioneer, Metahelix etc.)
  - Technology providers (e.g. Ankur Scientific Technologies, etc.)
  - Infrastructure Leasing & Financial Services (IL&FS)
  - All India Rice Exporters Association (AIREA)
- **NGOs**
  - Pradan, BASIX, Livolink
- **Institutes / Universities**
  - Indian Council of Agricultural Research (ICAR)
  - International Food Policy Research Institute (IFPRI)
  - Central Rice Research Institute (CRRI)
  - International Rice Research Institute (IRRI)
  - Cereal Systems Initiative for South Asia (CSISA)
- **Various BMGF Program Officers**

## Fieldwork
- **120+ farmers across 5 districts**
  - Gaya, Rohtas, Nalanda, Bhagalpur, Muzaffarpur
- **100+ other value chain players**
  - Traders, brokers, millers, wholesalers
- **Local government officials**
  - District Agriculture Officers
  - District extension officers
  - Primary Agriculture Cooperative Society officers
- **Field teams** of various private/NGO players
  - Input provider field teams
  - NGO fieldworkers

## Secondary Sources
- **Ministry of Agriculture data**
- Bihar Department of Agriculture data
- Govt. of India Planning Commission
- National Sample Survey Organisation (NSSO)
- Census of India
- Govt. websites (e.g. Department of Energy, FCI, etc.)
- International Food Policy Research Institute (IFPRI) reports
- United Nations World Food Programme
- Press
Agenda

Project approach

Supply-demand dynamics

Value chain & constraints

Policy & government context

Prioritized interventions
While India has managed to attain rice self-sufficiency and build a rice surplus...

- Rice production has generally been able to meet consumption
- Negligible imports since 1985
- Government has managed to amass considerable stocks

Source: United States Department of Agriculture, Production, Supply & Distribution Online
...there are still pockets of deficit, including Bihar

BIHAR IS ONE OF THE REMAINING RICE DEFICIENT STATES

CONSUMPTION IN BIHAR CONTINUES TO EXCEED PRODUCTION

Note: * 2009-10 figures
Source: Census of India; Department of Agriculture and Cooperation; Household Consumer Expenditure Survey; Ministry of Statistics and Programme Implementation; Bihar Department of Agriculture
Rice demand in Bihar will increase further over medium term

~20% DEMAND GROWTH BY 2025

DRIVEN BY POPULATION GROWTH...

• Population expected to grow by ~13m by 2025
• Assuming constant consumption of ~82kg p.a., add. ~1 m MT of rice will be required by 2025
• Negligible impact of urbanization

...AND LATENT DEMAND BEING MET

Food insecure* (26 million residents) ~0.7 million MT (assumes additional 300 cal / 75 gm rice per day)

Note: * Consuming between 1,800 kcal and 2,400 kcal per day
Source: GoI Census; Census on India 2001; UN World Food Programme; Team analysis
There is significant scope to increase rice yield in Bihar to address this deficit

<table>
<thead>
<tr>
<th>AREA</th>
<th>x</th>
<th>YIELD</th>
<th>=</th>
<th>PRODUCTION</th>
</tr>
</thead>
</table>

*BGREI = Bringing Green Revolution to Eastern India; NFSM = National Food Security Mission
Note: *2009-10 data last estimate; ^2010-11 and 2011-12 data fourth advance estimates
Source: Department of Agriculture, Bihar
This would not only address food insecurity…

~25% OF BIHAR IS FOOD INSECURE

Breakdown of Bihar population (millions)

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

Bihar

Food secure
Food insecure

26

78

104

RICE FORMS A LARGE PART OF THE DIET, PARTICULARLY IN RURAL AREAS

Equiv. annual consumption:
Rural ~84kg
Urban ~72kg

Bihar avg. consumption per capita of rice, wheat and other cereals over 30 days (kg)

<table>
<thead>
<tr>
<th>Year</th>
<th>Rice</th>
<th>Wheat</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005-06</td>
<td>12.9</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>2006-07</td>
<td>13.1</td>
<td></td>
<td>9.5</td>
</tr>
<tr>
<td>2007-08</td>
<td>12.9</td>
<td></td>
<td>9.2</td>
</tr>
<tr>
<td>2005-06</td>
<td>12.4</td>
<td></td>
<td>9.7</td>
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<tr>
<td>2006-07</td>
<td>12.4</td>
<td></td>
<td>9.7</td>
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<tr>
<td>2007-08</td>
<td>12.7</td>
<td></td>
<td>9.6</td>
</tr>
</tbody>
</table>

Note: * Consuming between 1,800 kcal and 2,400 kcal per day
Source: Govt. of India; Planning Commission; UN World Food Programme; 2011 Census
...but also poverty, given the number of households involved in rice farming

Note: 2009-10 is the most recent state-wide poverty data. The all-India poverty line (daily per capita consumption expenditure) is Rs. 22 in rural areas and Rs. 28 in urban areas. The poverty line varies by state and in Bihar it is Rs. 22 in rural areas and Rs. 26 in urban areas.

Source: Ministry of Agriculture, GoI; Bihar Department of Agriculture; “Household Consumer Expenditure in India”, National Sample Survey Org.
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- Project approach
- Supply-demand dynamics
- Value chain & constraints
- Policy & government context
- Prioritized interventions
Paddy farming is unprofitable once opportunity cost of family labor is included

Equivalent to Rs. 920 per quintal, a ~15% discount to MSP

Low quality, OPV parboiled rice example

Farming is unprofitable once opportunity cost of family labor is included, despite fact farmers take on greatest risk and deploy working capital for ~3-4 months

Note: Estimation based on field interview and market visits. Interviews in Gaya, Rohtas and Nalanda. Opportunity cost of family labour based on estimated average hours of farm work per day (including supervision time) for family members and average daily wage rates in Bihar.

Sources: Primary interviews; Team analysis
One can broadly distinguish between subsistence and surplus farmers, both in terms of profile and value chain linkages

<table>
<thead>
<tr>
<th><strong>Landholding size</strong></th>
<th>SUBSISTENCE FARMERS</th>
<th>SURPLUS FARMERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg. ~0.2-0.3 ha</td>
<td>• Avg. ~0.2-0.3 ha</td>
<td>• ~0.8-1.0 ha</td>
</tr>
<tr>
<td></td>
<td>• These marginal farmers tend to be interspersed amongst small-to-medium surplus farmers</td>
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<table>
<thead>
<tr>
<th><strong>Avg. annual income</strong></th>
<th>SUBSISTENCE FARMERS</th>
<th>SURPLUS FARMERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(2011 est.)</td>
<td>~Rs. 13,750 ($250) per capita</td>
<td>~Rs. 24,750 ($450) per capita</td>
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<table>
<thead>
<tr>
<th><strong>Season</strong></th>
<th>SUBSISTENCE FARMERS</th>
<th>SURPLUS FARMERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predominantly <em>kharif</em> (Aug-Nov/Dec)</td>
<td>Predominantly <em>kharif</em></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Common cropping systems</strong></th>
<th>SUBSISTENCE FARMERS</th>
<th>SURPLUS FARMERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main crop is rice <em>kharif</em> crop</td>
<td>More prominent <em>rabi</em> crop</td>
<td></td>
</tr>
<tr>
<td>Small <em>rabi</em> crop (Dec/Jan – Mar/Apr) of wheat or maize (in irrigated areas) or pulses, oilseeds (in non-irrigated areas)</td>
<td>Typically rice-wheat or rice-maize</td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th><strong>Subsistence vs. commercial</strong></th>
<th>SUBSISTENCE FARMERS</th>
<th>SURPLUS FARMERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growing for subsistence only</td>
<td>Sell at least some of the paddy grown</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Irrigation</strong></th>
<th>SUBSISTENCE FARMERS</th>
<th>SURPLUS FARMERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>~60% of paddy area with irrigation potential in Bihar, typically via borewell with limited amount of canal irrigation</td>
<td>More likely to own borewell pumps and thus have better access to irrigation</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Value chain linkages</strong></th>
<th>SUBSISTENCE FARMERS</th>
<th>SURPLUS FARMERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value chain linkages present but relatively weak across the chain, from input supply to market access</td>
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<td></td>
</tr>
<tr>
<td>Similar VC linkages to surplus farmers (given they are interspersed amongst them)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exception is drought-prone areas, where input supply chain is relatively weak (<em>see next slide</em>)</td>
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<td></td>
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*Total income; not just income from paddy cultivation
Source: Planning Commission Estimates, 2011 Census
One subset of subsistence farmers worth highlighting are drought-prone farmers, clustered in south of the state.

**Drought Prone Areas (20% area)**
- Majority of farmers are subsistence
- This drought-prone sub-set of subsistence farmers has broadly same characteristics as subsistence farmers generally, apart from higher risk profile and weaker input supply chain given small-scale rabi crop
  - *Rabi* crop (Dec/Jan – Mar/Apr) typically more input intensive than *kharif* crop
  - In drought-prone areas, *rabi* crop often grown on residual moisture only, with minimal use of inputs

**Flood Prone Areas (15% area)**
- Most farmers typically have productivity equal to non-stress affected areas
  - Apart from farmers in between river and embankment, who do suffer crop damage in bad flood years
  - Other farmers benefit from highly fertile soil
- These farmers also have a prominent *rabi* crop

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% Area under irrigation

- < 25 %
- 25% - 50%
- 50% - 75%
- > 75%

Drought Prone

Flood Prone

Most severely drought-affected districts are Aurangabad, Gaya, Nawada, Sheikhpura, Lakhi Sarai, Jamui, Munger

Source: Economic Survey, Govt. of Bihar; Dept. of Agriculture, Bihar; Primary interviews
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Project approach

Supply-demand dynamics

Value chain & constraints

Surplus areas

Tribal areas

Policy & government context

Prioritized interventions
Average surplus farmer earns ~Rs. 8,500 per ha, with labour representing largest cost

**SURPLUS FARMERS**

- **Avg. yield:** ~3.8-4.0T per ha (paddy)
  ~2.5-2.7T per ha (rice)
- **Avg. land holding:** 0.8-1.0 ha

Represents ~24% margin. However, once opportunity cost of family labour (est. at ~Rs. 9,400) is included farming is unprofitable.

Note: Estimation based on field interviews in Gaya, Rohtas, Nalanda and Bhagalpur districts. Entire sample not using “SRI” practices. Analysis assumes all paddy sold. Opportunity cost of family labour based on estimated average hours of farm work per day (including supervision time) for family members and average daily wage rates in Bihar.

Source: Primary interviews; Team analysis
# Key constraints are seeds, agronomic practices, mechanization, & inter-related set of issues around market access

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Severity</th>
<th>Issues</th>
<th>Est. yield impact if resolved*</th>
<th>Est. income impact if resolved^</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeds</td>
<td></td>
<td>• Farmers do not receive quality seed at right time due to quality control &amp; distribution challenges at Bihar State Seed Corp., dominant seed provider</td>
<td>~15%</td>
<td>~50%</td>
</tr>
<tr>
<td>Fertiliser</td>
<td></td>
<td>• Access to fertiliser reasonable with high farmer awareness about benefits, though balanced application is a major issue</td>
<td>~15%</td>
<td>~20%</td>
</tr>
<tr>
<td>Pesticides/ herbicides</td>
<td></td>
<td>• While usage is low, less of a constraint as there is no government distortion in this sector i.e. no subsidies</td>
<td>~5%</td>
<td>~15%</td>
</tr>
<tr>
<td>Irrigation</td>
<td></td>
<td>• Key challenge is cost (due to high diesel prices). Farmers typically carry out ‘emergency’ irrigation if required, reducing incomes</td>
<td>~50%</td>
<td>~160%</td>
</tr>
<tr>
<td>Access to credit</td>
<td></td>
<td>• Not preventing farmers from using improved inputs/practices; vast majority of farmers do not take loans for paddy cultivation</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Agronomic practices</td>
<td></td>
<td>• Knowledge and labour availability are the key constraints. Some farmers aware of the benefits of line transplanting, young seedlings, etc., but do not have labour resources to adopt them</td>
<td>~20%</td>
<td>~55%</td>
</tr>
<tr>
<td>Mechanisation/labour</td>
<td></td>
<td>• Low mechanization rates contributing to continuation of out-dated practices. Rising labour costs will exacerbate this constraint</td>
<td>~5%</td>
<td>~30%</td>
</tr>
<tr>
<td>Post-harvest</td>
<td></td>
<td>• Most have access to threshing machines and some storage facilities (mud huts), even if not particularly good quality</td>
<td>~5%^</td>
<td>~20%</td>
</tr>
<tr>
<td>Market access</td>
<td></td>
<td>• Govt. procurement system inefficient; many farmers unable to access it directly. Most farmers sell paddy to traders at a ~15-20% below MSP.</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Milling</td>
<td></td>
<td>• Inadequate milling capacity in Bihar, though sufficient capacity in neighbouring states to absorb gap. Leads to 5-10% price penalty vs. neighbouring states due to transport inefficiency</td>
<td>NA</td>
<td>~70%**</td>
</tr>
<tr>
<td>Infrastructure</td>
<td></td>
<td>• One of the poorest in country in terms of both roads and electricity; a key driver of inadequate milling capacity</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

* Full potential / theoretical impact (not actual on-farm impact); ^Income impact calculated based on income from paddy (~Rs. 8,500 per ha), not total farmer income; **Assuming farmers could achieve full MSP; ^Due to less wastage
Seeds, mechanisation and agronomic practices have significant income impact & relatively high addressability; market access more challenging to address but has even greater impact on incomes.

Source: Primary interviews; Team analysis
Seeds: Surplus farmers not able to access right varieties of seed at the right time

KEY ISSUES ARE SUPPLY OF APPROPRIATE QUALITY SEEDS & FARMER AWARENESS

<table>
<thead>
<tr>
<th>Issues</th>
<th>Severity</th>
<th>Description</th>
</tr>
</thead>
</table>
| Availability | • Insufficient availability of quality seeds, due to *weak quality control processes* and lack of adequate *storage & processing facilities*  
• Bihar State Seed Corporation (monopoly HYV seed player) has *weak distribution network* |
| Affordability | • HYV seeds available at ~Rs. 20-30/kg under *govt. subsidy* (though high subsidy only to govt. seeds crowds out private sector in HYVs)  
• Hyv hybrid seeds are also relatively affordable at ~Rs. 50-60/kg after subsidy (Rs. 200/kg or ~80% subsidy; up to 6 kg) |
| Awareness  | • Lack of awareness of new varieties vs. Mansuri, Swarna  
• Very limited awareness of stress-tolerant varieties, particularly Sahbhagi Dhan |
| Appropriateness | • Pre-dominant variety is *Mansuri*, an older *variety* which is becoming increasingly pest-prone; newer, improved varieties are available  
• While uptake of Swarna Sub-1 is improving, adoption of *Sahbhaghi Dhan* still negligible |

- ~40% BSSC DISTRIBUTION IS STILL MANSURI

Source: Govt. of Bihar; Bihar Agricultural Roadmap; Bihar State Seed Corporation; Primary interviews
Agronomic practices: Remain extremely poor due to weak govt. extension, even amongst larger surplus farmers

WHILE GOVT. HAS LAUNCHED MANY INITIATIVES, EXTENSION REMAINS WEAK

- Improving extension services was a **significant focus of 11th Five Year Plan (2007-12)**, and has continued in **12th Five Year Plan (2012-2017)**

- **Several new initiatives launched**
  - Induction of Subject Matter Specialists at the sub-block level and ‘Krishi Salahkar’ (Agricultural Advisor) at the Panchayat* level
  - Training program for farmers through ‘Krishi Pathshala’ (Agricultural School)
  - Series of ‘Kishan Vikash Shiwir’ (Farmer Development Camps) to provide a platform for technology transfer amongst farmers
  - Monthly *Kisan melas* (Farmer Fairs) at district level
  - Minikit demonstrations at the Panchayat or village level

**EVEN SUCCESS OF RECENT “SRI” DRIVE HAS BEEN MIXED**

- 2011 was the “**Year of SRI**” (System of Rice Intensification), and a target set for **350,000 hectares under SRI** in 2011-12

- **Subsidy program** introduced (Rs. 3000 / acre)
  - Subsidy includes seeds, fertilisers, micronutrients, irrigation and implements (cono-weeders)

- However, concern that focus is on meeting targets, **rather than effecting lasting change on practices**
  - Government is not monitoring who is adopting SRI properly
  - Meant to be SMSs but not taking place in reality

“I don’t think the subsidy model won’t work in the long term. Once the subsidies are rolled back in 3-4 years time, there will be serious challenges. There isn’t enough training and support manpower at the village level to ensure proper adoption of SRI practices. There may only be 1 SMS for 10,000 plus farmers.”

Paddy farmer, Nalanda

“I’m over 60 years old and throughout my life I haven’t seen much government involvement in extension services in our area. Yes, recently I have noticed some movements from them but they just come and go.”

Paddy Farmer, Nalanda

---

*Local administrative level in India; composed of several ‘blocks’, which in turn are composed of several villages

Source: Bihar Economic Survey 2012; Planning Commission; Special Task Force on Bihar; Primary Interviews; Lit Search
Agronomic practices: Other extension providers have been more effective, but current reach is relatively limited (vs. govt.)

<table>
<thead>
<tr>
<th>Jeevika</th>
</tr>
</thead>
<tbody>
<tr>
<td>Started in 2007 with aim of reducing poverty amongst rural households by building community-based orgs.</td>
</tr>
<tr>
<td>As part of its programs, has promoted improved agronomic practices (under the name of “SRI”)</td>
</tr>
<tr>
<td>Co-contribution model, which results in greater ownership from farmers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Promoting “SRI” in 2 of the poorest districts of Bihar</td>
</tr>
<tr>
<td>In each block are ~15-20 VRPs (Village Resource Person)</td>
</tr>
<tr>
<td>1 VRP is connected to 40-50 farmers of the cluster</td>
</tr>
<tr>
<td>Farmers are selected on the basis of their caste and economic level</td>
</tr>
<tr>
<td>Started work with Jeevika in Dec 2012 for the extension and expansion of livelihood activities through video communication</td>
</tr>
<tr>
<td>Train Village Resource Persons of Jeevika to shoot videos related to SRI, seed treatment, etc. These videos are edited by VRPs themselves and they are screened in the villages.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reach</th>
</tr>
</thead>
<tbody>
<tr>
<td>~30,000 farmers involved in “SRI” program in 9 districts of Bihar</td>
</tr>
<tr>
<td>~580,000 households mobilised into SHGs (till May ‘12)</td>
</tr>
<tr>
<td>~26,000 farmers involved in “SRI” program in 2 districts of Bihar</td>
</tr>
<tr>
<td>Current reach is ~6500 farmers in ~100 villages</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rs. 3.9B ($70M) in initial tranche (till 2015) - 90% World Bank, 10% State Govt</td>
</tr>
<tr>
<td>Additional Rs. 7.7B ($140M) in 2012</td>
</tr>
<tr>
<td>Rs. 64M ($1.2M) funding in Bihar</td>
</tr>
<tr>
<td>~55% funding from Sir Dorabji Tata Trust, ~35% from Jeevika, with remainder from other donors incl. BMGF</td>
</tr>
<tr>
<td>Funded by BMGF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aspiration</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Govt. plans to cover 12.5M households and all 38 districts within 10 years</td>
</tr>
<tr>
<td>Plan to expand to adjoining districts like Jahanabad, Arwal, Aurangabad and Nawada in 2013 as these districts are very poor and Naxalite prone areas</td>
</tr>
<tr>
<td>Plan to extend by ~6000 villages by the year 2015</td>
</tr>
<tr>
<td>Plan to train ~6000 VRPs and have ~2000 videos by the end of 2015</td>
</tr>
</tbody>
</table>

Source: Primary interviews, Organization websites; Lit. Search
Agronomic practices: In the field, Jeevika farmers have been achieving ~50% yield increase in Nalanda, with a tripling in profit per ha

<table>
<thead>
<tr>
<th>TRADITIONAL</th>
<th>MODIFIED SRI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Avg. yield:</strong> 43 qtls per ha</td>
<td><strong>Avg. yield:</strong> 67 qtls per ha</td>
</tr>
<tr>
<td><strong>Avg. land holding:</strong> 1.6 ha</td>
<td><strong>Avg. land holding:</strong> 2.0 ha</td>
</tr>
</tbody>
</table>

Represents ~29% profitability

Nalanda District
“Modified SRI” promoted by Jeevika

Represents ~55% profitability

Note: Estimation based on field interviews in Nalanda district. Excludes cost of family labour.
Sources: Primary interviews; Team analysis
Mechanization/Labour: Low levels of mechanization contributing to unprofitability of paddy farming in Bihar

**TRACTOR MECHANIZATION IS PICKING UP IN BIHAR, BUT OFF A LOW BASE**

<table>
<thead>
<tr>
<th>State</th>
<th>Tractor Sales per 000 Ha Net Sown Land FY12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other States</td>
<td>2</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>4</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>5</td>
</tr>
<tr>
<td>MP</td>
<td>6</td>
</tr>
<tr>
<td>A.P.</td>
<td>7</td>
</tr>
<tr>
<td>Bihar</td>
<td>8</td>
</tr>
<tr>
<td>U.P.</td>
<td>9</td>
</tr>
<tr>
<td>Punjab</td>
<td>5</td>
</tr>
</tbody>
</table>

National avg. = 4.3

**PENETRATION OF EQUIPMENT STILL EXTREMELY LOW**

- Still typically **only 1 tractor available per village** at max; often shared between 2-3 villages
- **~3-4 power tillers** present at every block (~100 villages)
- **~1 combine harvester** for every ~3-4 villages
- Most farmers **not even aware of mechanized transplanters**

**LOW MECHANIZATION HAS ADVERSE EFFECT ON FARMER INCOMES**

"The Bihar market, where tractor penetration had been low historically, has shown **sustained growth** over the last few years."

ICRA, May 2010*

"The machines are **too costly** for us to afford. Also the machines we’ve seen are **too big** to be used in our small land holdings."

Paddy Farmer, Nalanda

"Last year we adopted sri-vidhi (SRI), but this year due to the **unavailability of labor** and **split up** of my family, we did the cultivation by traditional method."

Paddy Farmer, Gaya

---

Note: *Investment Information & Credit Rating Agency of India. Opportunity cost of family labour based on estimated average hours of farm work per day (including supervision time) for family members and average daily wage rates in Bihar.

Source: ICRA; Primary interviews
Mechanization/Labour: Mechanization solutions exist for smallholders which would result in significant cost savings, CSISA promoting a ‘service provider’ model in 10 districts

**LAND PREPARATION**

<table>
<thead>
<tr>
<th>Cost Per Hectare (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>Traditional Plough</td>
</tr>
</tbody>
</table>

Smaller 45 HP tractors and 12 HP power tillers are ideal for smaller land holdings < 2 Ha

**TRANSPLANTING**

<table>
<thead>
<tr>
<th>Cost Per Hectare (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>Manual Labor</td>
</tr>
</tbody>
</table>

Walk-behind transplanters with a 4-stroke petrol engine and 2-speed transmission are a cost-effective option for small land holders

**HARVESTING**

<table>
<thead>
<tr>
<th>Cost Per Hectare (INR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>Manual Labor</td>
</tr>
</tbody>
</table>

Self-propelled wheel harvesters are an efficient option for small landholders

**CSISA model**

- CSISA working with ~600 service providers in 10 districts of Bihar, providing technical training and running farmer meetings to increase farmer awareness of mechanization solutions
- Focused on zero-till machines, predominantly for wheat crop (est. ~95% of associated farmers use zero-till machines for wheat; ~5% for rice). Also promoting tractors, combine harvesters, threshers, rice haulers and mechanised transplanters but at much smaller scale.

Note: The above analysis assumes that power tillers, tractors, and transplanters are rented on an hourly or daily basis; Land Preparation includes ploughing and harrowing; Rental rates for power tillers and transplanters are ~Rs.250/hour, tractors are ~Rs.425/hour, and harvesters are ~Rs.375/hour. ‘Manual Labor’ Costs include opportunity costs of family labor.
Source: Primary Interviews, NABARD, Mahindra and Mahindra
Mechanization would also directly lessen the burden on women in rice production

Women’s role in rice production in Bihar

<table>
<thead>
<tr>
<th>Production</th>
<th>Processing</th>
<th>Trading / retailing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land preparation</td>
<td>Nursery preparation</td>
<td>Threshing</td>
</tr>
<tr>
<td>• Carried out by men</td>
<td>• Majority work done by women</td>
<td>• Both men and women</td>
</tr>
<tr>
<td>• Both by physical (plough) and mechanical (tractor) means</td>
<td>• Carried out in or near household</td>
<td>• Men typically thresh and women carry paddy; collect loose grains etc.</td>
</tr>
<tr>
<td>Nursery preparation</td>
<td>Planting</td>
<td>Milling</td>
</tr>
<tr>
<td>• Majority work done by women</td>
<td>• Majority work done by women (for surplus areas)</td>
<td>• Typically carried out by men</td>
</tr>
<tr>
<td>• Carried out in or near household</td>
<td>• Delicate, careful work</td>
<td>• Includes parboiling process</td>
</tr>
<tr>
<td>• Requires careful supervision</td>
<td>• For tribal/subsistence farmers, entire household is engaged</td>
<td></td>
</tr>
<tr>
<td>Planting</td>
<td>Weeding</td>
<td></td>
</tr>
<tr>
<td>• Majority work done by women</td>
<td>• Majority done by women if done manually</td>
<td>• Typically carried out by men</td>
</tr>
<tr>
<td>• Carried out in or near household</td>
<td>• Delicate, careful work</td>
<td></td>
</tr>
<tr>
<td>• Requires careful supervision</td>
<td>• Men dominate the process if it is done mechanically</td>
<td></td>
</tr>
<tr>
<td>Weeding</td>
<td>Harvesting</td>
<td></td>
</tr>
<tr>
<td>• Majority work done by women</td>
<td>• Majority work done by women, and is generally done manually</td>
<td></td>
</tr>
<tr>
<td>• Carried out in or near household</td>
<td>• Delicate, careful work</td>
<td></td>
</tr>
<tr>
<td>• Requires careful supervision</td>
<td>• Men dominate the process if it is done mechanically</td>
<td></td>
</tr>
<tr>
<td>Harvesting</td>
<td>Threshing</td>
<td></td>
</tr>
<tr>
<td>• Majority work done by women</td>
<td>• Both men and women</td>
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</tr>
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<tr>
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</tr>
<tr>
<td>Threshing</td>
<td>Milling</td>
<td></td>
</tr>
<tr>
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<td></td>
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<tr>
<td>• Men typically thresh and women carry paddy; collect loose grains etc.</td>
<td>• Includes parboiling process</td>
<td></td>
</tr>
<tr>
<td>Milling</td>
<td>Trading / retailing</td>
<td></td>
</tr>
</tbody>
</table>

Preference for female labour often driven by lower wage rate

Source: Primary interviews
Market access/milling/infrastructure: Milling capacity shortage depressing farmer prices

MASSIVE ELECTRICITY SHORTAGE… ➔ HAS HAMPERED GROWTH OF MILLING INDUSTRY… ➔ WITH FARMERS PAYING THE PRICE

Power demand and supply in Bihar (MW, latest estimates\(^1\))

<table>
<thead>
<tr>
<th></th>
<th>Central Gov.</th>
<th>State Gov.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply</td>
<td>2,500</td>
<td>1,200</td>
</tr>
<tr>
<td>Demand</td>
<td>3,700</td>
<td>100</td>
</tr>
<tr>
<td>DEFICIT</td>
<td>1,200 MW</td>
<td></td>
</tr>
</tbody>
</table>

Currently ~30% milling capacity deficit; Electricity shortage main constraint to increasing capacity

- As a result of the shortage in milling capacity, ~30% of the paddy produced in Bihar flows out to other states for milling
  - States with excess milling capacity include Uttar Pradesh, Chhattisgarh, Andhra Pradesh and Punjab

- Farmers typically pay a price penalty of 5-10% vs. other states to account for additional transport costs
  - Bihar paddy farmers typically receive 15-20% below Minimum Support Price vs. 10-15% in other states

1 Based on Bihar State Electricity Board estimates.
Source: FCI; Bihar State Electricity Board; Primary interviews
Agenda

Introduction

Supply-demand dynamics

Market & policy context

Value chain & constraints

Surplus farmers

Subsistence farmers

Prioritized interventions
Profitability per hectare for subsistence farmers ~Rs.5,100, ~60% that of surplus farmers

Avg. yield: ~2.5T per ha (paddy)
~1.6-1.7T per ha (rice)
Avg. land holding: 0.2-0.3 ha

Notional price achieved if sold; in reality bulk of rice is consumed by these subsistence farmers

Represents ~23% margin. However, once opportunity cost of family labour (est. at ~Rs. 15,200) is included farming is unprofitable

Note: Entire sample not using “SRI” practices. Analysis assumes all paddy sold for purposes of modelling economics. Opportunity cost of family labour based on estimated average hours of farm work per day (including supervision time) for family members and average daily wage rates in Bihar.
Sources: Primary interviews; Team analysis
# Subsistence Farmers

For subsistence farmers, key constraints are seeds and agronomic practices.

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Severity</th>
<th>Issues</th>
<th>Est. yield impact if resolved*</th>
<th>Est. income impact if resolved^</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeds</td>
<td>1a</td>
<td>• Availability of newer HYVs and stress-tolerant varieties is similarly poor, with farmers even less educated on benefits. For drought-prone subset, availability of Sahbhagi Dhan a particularly critical constraint</td>
<td>~20%</td>
<td>~80%</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>1b</td>
<td>• For non-drought prone farmers, price, availability and awareness not significant constraints, but balanced application again an issue. Farmers in drought-prone areas would face availability and awareness challenges</td>
<td>~20%</td>
<td>~45%</td>
</tr>
<tr>
<td>Pesticides/herbicides</td>
<td>1c</td>
<td>• Lack of awareness; economic case for pesticides less clear for these subsistence farmers</td>
<td>~5%</td>
<td>~22%</td>
</tr>
<tr>
<td>Irrigation</td>
<td>1d</td>
<td>• For farmers with irrigation facilities, same affordability constraint as for surplus farmers, but impact on incomes more acute</td>
<td>~50%</td>
<td>~130%</td>
</tr>
<tr>
<td>Credit</td>
<td>1e</td>
<td>• Not preventing farmers from using improved inputs/practices</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Agronomic practices</td>
<td>2a</td>
<td>• Knowledge is the key constraint, with hardly any farmers practising line transplanting, young seedlings, single seedlings etc.</td>
<td>~30%</td>
<td>~95%</td>
</tr>
<tr>
<td>Mech./ labour</td>
<td>2b</td>
<td>• Labour is generally available within family and not currently a constraint, but if agronomic practices were to change basic mechanization would be required</td>
<td>~5%</td>
<td>~5%</td>
</tr>
<tr>
<td>Post-harvest</td>
<td>3</td>
<td>• As for surplus farmers</td>
<td>~5%</td>
<td>~20%</td>
</tr>
<tr>
<td>Milling</td>
<td>4</td>
<td>• On average, these subsistence farmers could absorb ~20-25% extra paddy through self-consumption. Sufficient capacity in neighbouring states to absorb marketable surplus, but at 5-10% discount due to transport inefficiency</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>5</td>
<td>• As for surplus farmers</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Market access</td>
<td>6</td>
<td>• Basic market linkages are in place such that these farmers can sell any excess paddy, though they may receive slightly lower prices (~20-25% below MSP) due to less bargaining power</td>
<td>NA</td>
<td>~85%**</td>
</tr>
</tbody>
</table>

*Full potential / theoretical impact (not actual on-farm impact); ^Income impact calculated based on income from paddy (~Rs. 5,100 per ha), not total farmer income; assumes farmers selling all their produce; **Assuming farmers could achieve full MSP

See Appendix for detail
These two constraints have significant income impact and relatively high addressability

Source: Primary interviews; Team analysis
Seeds: Similar issues as for surplus farmers, apart from drought-prone segment, where constraints are more severe

<table>
<thead>
<tr>
<th>Issues</th>
<th>Severity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td></td>
<td>• Suffer from similar quality and distribution challenges, though subsistence farmers typically more severely affected</td>
</tr>
<tr>
<td>Affordability</td>
<td></td>
<td>• HYV seeds available at ~Rs. 20-30/kg under govt. subsidy (though high subsidy only to govt. crowds out pvt. sector)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Hybrid seeds are also relatively affordable at ~Rs. 50-60/kg after subsidy, though most subsistence farmers choose to use HYV</td>
</tr>
<tr>
<td>Awareness</td>
<td></td>
<td>• Lack of awareness of new varieties vs. Mansuri; as well as stress-tolerant varieties, particularly Sahbhagi Dhan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Even poorer awareness than surplus farmers</td>
</tr>
<tr>
<td>Appropriate-ness</td>
<td></td>
<td>• Pre-dominant variety is Mansuri</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Negligible adoption of Sahbhagi Dhan in drought-prone areas</td>
</tr>
</tbody>
</table>

**SIMILAR CONSTRAINTS TO SURPLUS FARMERS, BUT SLIGHTLY MORE SEVERE**

**DROUGHT-PRONE FARMERS DO NOT HAVE ACCESS TO SAHGBHAGI DHAN**

• While Swarna Sub-1 touching ~15% of total seeds distributed via Bihar State Seed Corporation, Sahbhagi Dhan is still at demonstration stage
  - Only 29 qtls of Sahbhagi Dhan seed distributed during Kharif 2012-13
• Bihar State Seed Corporation reach poorer in southern, drought-prone districts

“Sahbhagi Dhan is only at the demonstration stage – it has not achieved mass popularisation as of now. We do have the intention of taking it to the drought-prone areas of southern Bihar, but this may take some time given our strongest presence is in central Bihar.”

Official, Bihar State Seed Corporation

Source: Bihar State Seed Corporation; Primary interviews
Agronomic practices: Practices lag those of surplus farmers

SIG. YIELD GAP TO SURPLUS FARMERS; POOR PRACTICES A KEY CONTRIBUTOR

Yield of subsistence farmers only ~60% of surplus farmers

USE OF OUT-DATED PRACTICES MAINLY DUE TO KNOWLEDGE GAP

- **Traditional methods** (e.g. haphazard planting of 25-30 day-old seedlings) are still practiced by majority of subsistence farmers
  - Still not aware of line transplanting and sowing 1-2 seedling per hill
  - The seedlings are sown in a very less distance and the number per hill is ~3-4

- Marginal subsistence farmers typically have even less access to government extension services vs. larger surplus farmers, even in the same block

“We have heard of sri-vidhi (SRI), but we actually don’t know how to grow paddy by this method. No-one from the government takes the pain to come to our village and demonstrate the sri-vidhi method to us and teach us the method.”

Paddy farmer, Sasaram

Source: Primary interviews
Agenda

Project approach

Supply-demand dynamics

Value chain & constraints

Policy & government context

Prioritized interventions
Central and state government making significant investments in agri. sector

GOI AG. SPEND GROWING AT ~7%; FOCUS ON EXTENSION AND POST-HARVEST MGMT

ALMOST $30B PLANNED EXPENDITURE IN BIHAR AGRI. SECTOR OVER 2012-2017

GOI = Govt. of India

Note: Crop husbandry includes funding for Rashtriya Krishni Vikas Yojna (RKVY) and extension (including promotion of seeds, fertilizer, farm mechanization etc.); Figures exclude subsidies (considered non-Plan expenditure)

Source: Planning Commission; Ministry of Agriculture, GoI; FCI; Union Budget 2012-13; Bihar Agriculture Roadmap
Govt. causes distortion in rice marketing through imposition of floor price and large scale procurement and distribution

### Minimum Support Price

- **Central guidelines**
  - Before each *rabi/kharif* harvest season **MSP announced by central government**
    - Based on recommendation of Commission of Agricultural Costs and Prices (CACP)
    - Takes into consideration cost of various agri. inputs and reasonable margin for farmers for their produce
  - **Food Corporation of India (FCI) acts as nodal central agency** to oversee procurement of paddy under price support scheme

- **State interpretations**
  - State government **free to set MSP higher than central recommendation**
    - Bihar State Govt. has not set a higher MSP
  - Many states – including Bihar – **take leading role in government paddy procurement** at MSP under ‘decentralised’ procurement scheme’
    - Bihar State Govt. through Bihar State Food and Civil Supplies Corporation (BSFC) **undertakes direct purchase** of paddy and **procurement** of custom milled rice on behalf of central government

### Public Distribution System

- **Every month, central government releases a prescribed amount of stocks to each state for distribution under PDS** which sells rice at subsidised prices to target populations
  - FCI responsible for transport of rice from surplus states to deficit states
  - **Beneficiaries include BPL (Below Poverty Line), APL (Above Poverty Line), and AAY (Antyodaya Anna Yojna)**

- **Rice sold under PDS at the following prices:**
  - APL: Rs.9.05/kg
  - BPL: Rs. 6.78/kg
  - AAY: Rs. 3.00/kg

- **BSFC manages distribution of PDS rice via Fair Price Shops and all inter-district transfers**
  - Imports rice from FCI to meet deficit

Source: FCI, BSFC, PDS Portal of India websites; Lit. Search
Bihar procurement infrastructure relatively weak, with many farmers receiving ~15-20% below MSP

BIHAR PROCUREMENT OPERATIONS BEGAN RECENTLY & REMAIN CHALLENGED

- **Negligible govt. procurement** (of both rice and wheat) in Bihar **before 2007-08**; only ~20% currently
  - Below national average of ~30% and far behind front-runners Punjab and Chhattisgarh (~80%)

- **As a result, procurement infrastructure in state underdeveloped**
  - Insufficient infrastructure (procurement centres, storage etc.)
  - Lack of adequate credit facilities to ensure timely payment
  - Lack of proper management systems and oversight

- **Majority of PACS** (Primary Agricultural Cooperative Societies) – key procurement agent - also **ineffective**
  - ~70% of govt. paddy procurement occurs through PACS

FARMERS OFTEN HAVE TO MAKE TRADE-OFF BETWEEN PRICE & PAYMENT TIMING

- While farmers **ostensibly should receive MSP** at PACS or State Food Corporation-run procurement centres, they face **several challenges**
  - Long delays in farmer payment, up to 2-3 months after delivery of paddy
  - Even at govt. centres, may still have produce rejected on pretext of poor quality (even if real problem is lack of storage space or capital to pay farmers)

- **As a result, many farmers choose to sell paddy at ~15-20% below MSP** to traders to receive faster payment
  - In these instances, average sale price reported by farmers is ~Rs.850-900 / quintal, 15-20% below the 2011-12 MSP of Rs.1,080 / quintal

“There is a huge potential of augmenting the procurement operations in Bihar, which is evident from the fact that only about 10% of the wheat and about 15-20% of the total rice produced in the state, is procured by Government agencies… State Government has not been able to create the requisite infrastructure in terms of Storage Space, Manpower etc. and thereby procurement operations are not carried out in the desired manner.”

Working Group on Food Grains, Ministry of Ag., GOI
Limited regulations in milling sector, with majority of paddy being freely milled for open market either within Bihar or in other states.

**Custom milling**
BSFC (primarily via PACS) procures rice; millers mill rice for government using a ‘fee-for-service’ model.

**Levy**
Miller procures rice from farmers at or above MSP but must deliver 50% to government; is free to sell remainder on open market.

**100% Open market milling**
- **In State**
  A miller can choose not to sign-up for custom milling and mill 100% for open market.

- **Out of state**
  Paddy transported out of state for milling; due shortage of milling capacity in Bihar.

**Milling for self-consumption**
Done in small village mills / rice hullers on a fee-for-service basis.

*Based on estimated paddy production in state of ~13 million MT paddy (vs. officially reported ~10.5 million MT paddy).

^PACS = Primary Agricultural Cooperative Society; BSFC = Bihar State Food Corporation – govt. agency responsible for procurement.
Both custom milling and open market milling are profitable with lower working capital requirement key benefit of custom milling.

**Note:** Economics for Mansuri rice. Procurement costs, revenues and margins are higher for Katarni / aromatic rice; ** Paddy is typically procured below the MSP

Source: Interviews
While large-scale projects are underway to increase electricity supply, delays are likely

**STATE AND CENTRAL AUTHORITIES ARE COMMITTED TO INCREASING SUPPLY**

- CM Nitish Kumar has committed to achieving an energy surplus in Bihar by 2015
  - Kumar publicly committed not to run for the next state assembly polls if “we fail to provide electricity to each village in Bihar by 2015”
- At the federal level, the Central Electricity Authority has acknowledged the huge supply-demand electricity gap in Bihar, and has committed to alleviating the situation via additional power allocation, in a recent statement released in September 2012

**HOWEVER, DELAYS ARE EXPECTED**

- Experts suggest **2017-18 is a more realistic timeframe** for completion of upcoming power projects

  “There are always delays to power projects and it’s hard to predict exactly when we will get power. It could be in 2015 or 2018 or even 2020.”
  
  President of Nokha Rice Millers Association

“Execution delays are difficult to prevent and can occur for a number of reasons including obtaining environmental clearance, establishing coal linkages with other states, gaining access to the required land and obtaining plant machinery in the stipulated timeframe.”

Official, Bihar Department of Energy

<table>
<thead>
<tr>
<th>Upcoming power projects</th>
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<tbody>
<tr>
<td><strong>Expected commissioning date</strong></td>
</tr>
<tr>
<td>2012-13</td>
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<td>2014</td>
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<td>2015-16</td>
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Note: * Bihar State Electricity Board

Source: Bihar Department of Energy; Bihar State Electricity Board; Press
Biomass-diesel co-generation is economically viable as an interim solution and is being adopted by existing and new mills

**POWER GENERATION USING BIOMASS IS SIG. CHEAPER THAN USING DIESEL ONLY**

<table>
<thead>
<tr>
<th>Cost of power generation</th>
<th>Rs. / kW</th>
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<tbody>
<tr>
<td>Biomass only</td>
<td>16</td>
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<tr>
<td>Biomass / diesel</td>
<td>14 (-60%)</td>
</tr>
<tr>
<td>Diesel only</td>
<td>12 (-80%)</td>
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<tr>
<td>Grid electricity</td>
<td>6</td>
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For biomass-diesel co-generation, husk requirements are met entirely through milling process, whereas for biomass only, additional husk must be purchased.

**DUAL-FUEL GENERATOR SETS ADOPTION TAKING OFF IN BIHAR**

- Taking into account capital costs, dual-fuel generation has more attractive economics than stand-alone biomass.
  - A biomass gasifier can be added to a diesel generator set for dual fuel power generation for Rs. 3-7 million, representing less than 10% of the total plant cost.
  - A stand-alone biomass generator costs ~Rs. 35 million.

- Government support, including a 50% subsidy for all captive power generation sets.

- Due to its financial viability, the adoption of biomass gasifiers by rice mills has increased significantly since 2009 and double-digit growth is expected in medium term.
  - Awareness amongst rice millers now high.

“Millers, particularly new millers, who do not adopt this type of technology are unlikely to survive in the future because diesel costs are so high and the supply of grid electricity is limited”

Kamla Agro Rice Mill (large rice mill, Banka)

Note: *Assumes 70% biomass and 30% diesel
Source: Ankur Scientific Technologies; Primary interviews

"Millers, particularly new millers, who do not adopt this type of technology are unlikely to survive in the future because diesel costs are so high and the supply of grid electricity is limited”

Kamla Agro Rice Mill (large rice mill, Banka)
Agenda

Introduction

Supply-demand dynamics

Market & policy context

Value chain & constraints

Prioritized interventions
Given prioritized policy and value chain constraints we suggest an integrated intervention approach

### Key value chain constraints

- **Seeds** – for both surplus & subsistence farmers: Quality and timely distribution of seeds an issue; Human resource gaps in the management ranks of Bihar State Seed Corporation (currently CEO position is vacant)

- **Agronomic practices** – for both surplus & subsistence: Out-dated practices in use due to limited reach and effectiveness of govt. extension

- **Mechanization** – for surplus farmers: Level of basic farm mechanization remains low

- **Market access, milling, infrastructure** – for surplus areas: Majority of farmers not receiving MSP due to poorly managed procurement systems. Further price penalty of ~5-10% due to inadequate milling capacity in Bihar.

### Key policy constraints

- **Market access**: Inefficiency and ineffectiveness of govt. procurement systems mean many farmers do not receive MSP

- **Infrastructure**: Significant electricity deficit in Bihar; while an improvement a priority for govt., delays appear likely

### Interventions

**Sign overarching MOU with State Government to drive integrated set of interventions**

- **Seed commercialization**
  - Work with Bihar State Seed Corp. to conduct data-driven diagnostic to build alignment on key challenges
  - Develop management skills/ fill resource gap
  - Identify ways for pvt. sector to play larger role

- **Mechanization service provider model**
  - In non-CSISA districts, link entrepreneurial farmers to equipment manufacturers and provide them with training, support and access to credit so that they can purchase equipment and rent it out to others

- **Facilitate co-ordinated extension approach**
  - Minimise overlap and enable leveraging each extension provider’s respective strengths

- **Build milling capacity** to improve farmer price realisation
  - E.g. Pilot small-scale mills owned and run by Farmer Producer Organizations which will procure at MSP and enable farmers to capture additional value from milling
  - Work with govt. to create appropriate ecosystem for large-scale private milling e.g. stable electricity supply, access to capital etc.

Source: Technoserve
This set of interventions will address all key constraints identified

<table>
<thead>
<tr>
<th>Seeds</th>
<th>Fertiliser</th>
<th>Pesticides/herbicides</th>
<th>Irrigation</th>
<th>Access to credit</th>
<th>Agro-nomic practices</th>
<th>Mech./labour</th>
<th>Post-harvest</th>
<th>Milling</th>
<th>Market access</th>
<th>Infra.</th>
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Key VC constraint – Subsistence

Key VC constraint – Surplus

Key policy constraint

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### Degree to which constraint addressed

- [ ] Fully addressed
- [ ] Partially addressed

**Source:** Team analysis
A broad-based MoU with State Govt. and independent Project Management Unit would be the best way to drive cooperation & capacity-building across multiple areas

INDEPENDENT PMU ONE HIGH POTENTIAL ROUTE TO BUILD CAPACITY AND TRUST

- Broad-based MoU at State Govt. level would provide platform for co-operation
  - Ideally medium term engagement of ~5 years
- Independent PMU will provide technical, managerial and design support
- Initial focus on seed diagnostic; can later expand to other areas (co-ordinated extension; FPO-run mill pilot etc.)

MOU USED IN U.P. TO FACILITATE CO-OPERATION ACROSS HEALTH AND AG.

- In Dec 2012, U.P. Chief Minister (CM) Akhilesh Yadav signed MoU with BMGF, following a meeting between Bill Gates and CM in May 2012

“The objective of the initiative will be to engage with the Gates Foundation to provide technical, managerial and programme design support in maternal, neonatal and child healthcare, vaccination and other health and agriculture-related programmes, the state government has also promised to lend its support to the foundation's initiatives to achieve shared objectives and to scale up best practices.”

Senior U.P. Govt. Bureaucrat, Dec 2012

Potential PMU structure

**Steering Committee**
- Composed of senior govt. officials and BMGF officers
- Cross-departmental/ functional representation (Agriculture, Industries, Energy, Rural Development,)

**Project Management Unit ‘CEO’**
- Professional with program management experience (Hired from market)

**Project team**
- Staffed by professionals (hired from market)
- Capability to do fact-based, hypothesis-driven diagnostics

Source: Team analysis
Work with State Seed Corporation to conduct a diagnostic and scope for private sector activity

WORK WITH STATE SEED CORPORATION TO DIAGNOSE KEY ISSUES

- Conduct robust, data-driven diagnostic to identify root causes of current issues and suggest potential actions
  - Management-consulting style approach
  - Close engagement with Bihar State Corporation team
- Assist in filling gaps in professional management and leadership
- Platform for building alignment and trust
  “We would definitely be open to a performance audit on our organisation, particularly one which drives towards real recommendations and suggestions for improvement.”
  MD, Bihar State Seed Corporation

IDENTIFY AREAS WHERE PRIVATE SECTOR COULD POSSIBLY PLAY A LARGER ROLE

- Explore potential of providing seed subsidies directly to farmers to encourage greater competition in HYV seed supply
  - Potentially leverage Aadhaar scheme, a universal unique identification project, or Kisan Credit Cards to deliver subsidy
  - At the same time work with Bihar State Seed Corporation to set them up to compete with private sector
- Consider outsourcing some seed processing activities to private sector
  - Private entrepreneurs provide processing services to State Seed Corporation for a fee
- Contract FPOs to multiply seeds, who would in turn contract to their constituent farmers
  - FPOs responsible for training, quality control etc.

Once alignment is built around key issues via diagnostic, partner with State Seed Corporation to implement required changes

Source: Primary interviews
Opportunity to fast-track mechanization by rolling out service provider model in non-CSISA districts

FAST-TRACK SERVICE PROVIDER MODEL IN NON-CSISA DISTRICTS

- While CSISA developing its zero-till machine / wheat-focused service provider model in 10 districts, opportunity to promote differentiated rice-focused model in remaining 28
  - CSISA’s model focused on zero-till technology, and as a result wheat crop (zero-till technology still at pilot / experimental stage for rice)
  - Proving a profitable service provider model for key equipment used in rice cultivation (e.g. tractors, power tillers, mechanised transplanters, combine harvesters) in non-CSISA districts will be a differentiated play which will fast-track mechanization in Bihar
- Create specific service provider ‘module/package’ with equipment manufacturer consortium and market it to smallholder farmers/co-operative groups
  - Clear articulation of economics
  - Provide package of business training and technical support
  - Assist with credit linkages

GOVT. VERY SUPPORTIVE OF MECHANIZATION, PARTICULARLY LOCAL MANUFACTURING

- State Govt. provides subsidies on agri. equipment above central allocation
- State Govt. also keen to attract equipment manufacturing units to Bihar
  - Considering subsidies and other benefits

“We would support mechanization in agri. sector in Bihar. In addition, we would like the equipment manufacturers to set up units in the state and we will provide a favourable business environment and potentially subsidies to them.”
Secretary of Industries, Bihar

Source: Primary interviews; Lit. Search
Economics are attractive for the service provider

The above analysis assumes a 10% ‘margin’ or down-payment required on total capital cost. All yearly profits are used to repay principal and interest until the entire loan is paid off. Tractor Analysis includes land-preparation and haulage rental activities.

Source: Primary Interviews, NABARD, Mahindra and Mahindra
Facilitate co-ordinated extension services to leverage each player’s strengths

**EACH PLAYER BRINGS DISTINCT STRENGTHS TO TABLE**

**State Govt.**
- **Largest extension provider** in state, with outreach to every district in Bihar
- Significant amounts of funding

**Jeevika (and other farmer-facing NGOs)**
- **Deep community** network via intensive hand-holding model
- Significant amounts of funding

**Digital Green**
- **Sustainable and low-cost model**

**Research institutes (incl. KVKs, agri. unis)**
- **New innovative technologies** (though farmer linkages currently weak)

**Input providers**
- Currently less active in extension, but could potentially represent a sustainable, business-driven model

**PLATFORM FOR DIALOGUE & CO-ORDINATION WILL MAXIMISE EFFECTIVENESS**

- Creating platform for dialogue amongst extension agencies will enable **more effective extension services**
  - Leverage respective strengths
  - Minimise overlap in activities
  - Co-ordinated approach to targeting of various districts
  - Share experiences and best practices

Source: Team analysis
FPO-operated mills appear profitable and have strong government support

RUNNING A MODERN BUT SMALLER-SCALE MILL IS PROFITABLE

<table>
<thead>
<tr>
<th>Rs. Per quintal of paddy</th>
<th>MSP</th>
<th>Op. cost</th>
<th>Margin</th>
<th>Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guaranteed procurement at MSP for FPO constituent farmers</td>
<td>1,080</td>
<td>90</td>
<td>30</td>
<td>1,200</td>
</tr>
</tbody>
</table>

Economics for ~2MT/hour (~8,000MT p.a.) modern rice mill
Fuel cost based on dual-fuel power generation (biomass and diesel)
Net capital cost* of Rs.19 million after 50% subsidy
Annual net profit of ~Rs. 2.8 million with payback period of ~7 years (assuming all profits are used to service loan)

SIGNIFICANT GOVERNMENT SUPPORT FOR FPO-OWNED MILLS

- The Government of Bihar’s Agriculture Roadmap has highlighted the role of cooperatives in the establishment of processing units including rice mills
- Funding provisioned under the Five Year Plan (2012-17) and the RKVY scheme entitle cooperatives to a 50% capital subsidy and 50% interest free loan to set up rice mills

“In principle the idea of a co-operative owned mill makes sense. Perhaps we could leverage the FPOs created by Jeevika for this purpose.”
Director of Agriculture, Bihar

“We would be open to piloting such FPO-owned mills. We currently are less focused on the market access side and this could be a way to begin in this area.”
CEO, Bihar Rural Livelihoods Promotion Society (BRLPS)

Note: Revenue based on sale of rice and by-products excluding husk, which is required for co-generation. *Excludes land cost. Includes boiler, drier, polisher, sorter, biomass / diesel generation set and 4,000MT godown
Source: FCI; Bihar Agriculture Roadmap; Interviews
A large donor could play the role of an ‘honest broker’ that facilitates communication between interested parties and expedites existing govt. schemes to increase milling capacity

**A DONOR COULD LEVERAGE ITS POSITION AND EXISTING GOVT. POLICIES TO INCREASE MILLING CAPACITY**

- A donor could fill a *gap in the value chain* by playing a convening role and facilitating communication between farmers, millers and various government departments.
- By capitalising on its position as a trustworthy third party, a large donor can **leverage existing government policies focused on setting up rice milling clusters**
  - Work with government to expedite the **timely supply and distribution of grid electricity** for the milling sector.
  - Improve access to **subsidies** for plant set-up, up-gradation and captive power generation.
  - Expedite the **application approval process** and the delivery of subsidies for new mills.
  - **Increase awareness** of government support programmes amongst millers.

**VARIOUS STAKEHOLDERS HAVE EXPRESSED INTEREST IN COLLABORATING WITH A LARGE DONOR**

"We would be very interested in working with a *large donor* like BMGF to *increase milling capacity* and improve the overall rice value chain in Bihar. I think there are a lot of opportunities we could pursue."

Principal Secretary, Bihar Department of Industries

"It is difficult to get the government to listen to us. We *really need a third party to facilitate communication* between the millers and the government because there is no open communication channel at the moment."

President, Nokha Rice Millers’ Association

"The millers say their interests are aligned with ours but they are only concerned with their profitability. We would *appreciate the efforts of an organisation like BMGF in setting up a common discussion forum*."

Paddy farmer, Rohtas

Source: Primary interviews
If executed and scaled effectively, interventions could have a sig. productivity & income impact on ~9M households

Note: *Assumes additional benefit from ‘getting everything right’; ^Benefits calculated assuming farmers are producing for market.
Source: Primary interviews; Team analysis
Phased intervention approach will enable progressively deeper and broader cooperation with State Govt. as trust grows

Start immediately
1-3 years

Build and scale
4-6 years

Longer-term
7-10 years

A. Seed diagnostic
   - Pilot and implement diagnostic recommendations

B. Mechanization via service provider model
   - Co-ordinated extension service provision

D. Pilot FPO-owned mill model
   - Refine and scale
   - Support milling cluster development

Source: Team analysis