Farm process outsourcing: promoting mechanization among sugarcane farmers through custom-hire services by agri-technology service providers

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Abstract With the increasing shortage of farm labor, completing various farm practices on time is becoming a serious challenge that is adversely affecting farm yields and profitability. In India, sugarcane cultivation is highly labor intensive crop and requires 352 work days per hectare, as against 171 for rice and 117 for wheat. Mechanization is not being adopted mainly due to the small holdings and because farmers cannot afford machines. Therefore, based on the concept of promoting an entrepreneurship-led approach through good agricultural practices in sugarcane cultivation, IFC (in collaboration with Solidaridad and two sugar companies (DSCL Sugars and Olam Agro India Ltd.)), under the India Sugar Advisory Farmers Support Programme, included as a component, the development of Agri-Technology Service Providers (ATSPs) to facilitate small-holding farmers. ATSPs are village-based farmers-cum-micro-entrepreneurs providing access to modern machines to fellow farmers, particularly small and marginal growers, on a custom-hire basis. The study involved key activities such as needs assessment, training, preparation of business plans, identification and introduction of suitable machines, linkages to local banks for funds to buy machines, etc. 71 ATSPs have been established. These ATSPs have procured different farm machines such as tractors, mechanized harvesters, land levelers, deep plows, semi-automatic planters, power tillers and power sprayers. This model has facilitated small-holding farmers to timely complete improved farm practices such as deep plowing (10,000 ha), land leveling (1,400 ha), trench planting (2,800 ha), mechanized planting (2,000 ha), inter-cultural operations/weeding (1,200 ha), trash shredding (330 ha), foliar spraying (2,800 ha), mechanized harvesting (263,000 t). It is well established that timely completion of these farm practices using modern machines improves yields and enhances farm incomes. It may be concluded that mechanization of sugarcane cultivation, even on small farmer fields, is possible through ATSPs.

Key words Shortage of farm labor, farmers as entrepreneurs, overall good farm management

INTRODUCTION

Agriculture is a significant sector of the Indian economy and the only means of living for almost two-thirds of workers in India. The Indian agriculture sector occupies 43% of India’s geographical area and contributes 16.1% of its GDP (Anonymous 2016). This is a significant contribution, even though it is currently declining. Indian farmers grow food crops, commercial crops, oil seeds, etc. Sugarcane is an important commercial crop.

India is the world’s second largest sugarcane producer, with sugarcane occupying about 3% of India’s total cultivated area and contributing about 7.5% of the gross value of agricultural production in the country. In 2015, sugar was a USD 6.3 billion industry and represented the principal livelihood of 35 million farmers (Anonymous 2015). Another 50 million people depend on employment generated by 571 sugar factories and other industries using sugar. Hence, sugarcane cultivation and the sugar industry play a vital role in the socio-economic development of Indian rural areas by mobilizing rural resources and generating higher incomes and employment opportunities.

However, sugarcane cultivation in India faces serious economic, environmental, and social challenges. Sugarcane areas are dwindling, leading to under-utilization of crushing machines due to the inadequate supplies of cane. High labor rates and lack of mechanization on small land-holder plots are mounting challenges for the sector. Non-completion of farm practices on time adversely affects productivity and thus reduces income from sugarcane.

India’s sugarcane-growing areas fall broadly into three agro-climatic regions: sub-tropical (northern India), tropical (south-Indian) and peninsular (western India) India. Major areas of sugarcane cultivation are in the sub-tropical belt. Uttar Pradesh, Uttarakhand and Bihar in the north and Maharashtra and Gujarat in the peninsular zone are important cane-
growing states. Sugarcane is also grown extensively in the tropical belt, including in the states of Andhra Pradesh, Karnataka and Tamil Nadu.

The average national yield of sugarcane (Fig. 1) has been 59-71 t/ha (Anonymous 2010) in the last decade, mainly due to non-implementation of the recommended package of farming practices due to non-availability of manual labor to undertake various practices on time. Skilled/educated rural youth do not want to work with manual tools in the field. However, the same people would prefer to work in the same fields if equipped with machines.

![Annual average sugarcane yield (t/ha) in India.](image)

The cultivation of sugarcane crop is highly labor intensive (Singh and Panghal 2009). As summarized in Table 1, more work-days (352 d) are required per hectare of sugarcane than in other crops such as rice (171 d) and wheat (117 ds). In fact, cultivation of rice and wheat has successfully been mechanized to a large extent and farmers have accepted it. Extensive studies by Singh and Sharma (2007) made recommendations to promote mechanization to reduce cost of sugar production and improve yield.

<table>
<thead>
<tr>
<th>Practice</th>
<th>Sugarcane</th>
<th>Rice</th>
<th>Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planting/sowing</td>
<td>35-40</td>
<td>35-40</td>
<td>10-12</td>
</tr>
<tr>
<td>Inter-cultural/weeding</td>
<td>65-70</td>
<td>25-30</td>
<td>22-25</td>
</tr>
<tr>
<td>Irrigation</td>
<td>10-12</td>
<td>10-12</td>
<td>8-10</td>
</tr>
<tr>
<td>Fertilizer</td>
<td>5-6</td>
<td>5-7</td>
<td>4-5</td>
</tr>
<tr>
<td>Harvesting, including detrashing/thrashing</td>
<td>150-200</td>
<td>60-70</td>
<td>35-40</td>
</tr>
<tr>
<td>Plant protection</td>
<td>12-15</td>
<td>4-5</td>
<td>4-5</td>
</tr>
<tr>
<td>Transport &amp; loading</td>
<td>20-25</td>
<td>6-7</td>
<td>15-20</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>352</strong></td>
<td><strong>171</strong></td>
<td><strong>117</strong></td>
</tr>
</tbody>
</table>

**Table 1.** Comparison of work days required to grow 1 ha of sugarcane, rice and wheat.

**CONSTRAINTS TO MECHANIZATION**

India is the largest manufacturer of tractors, accounting for one-third of global production. However, tractor density in India is 16 tractors for 1000 ha against World average of 19, and a USA average of 27 (Anonymous 2013). Sharma et al (2007) have mentioned that lack of emphasis on mechanization of sugarcane cultivation is mostly because, in the past, surplus manpower at cheap rates was widely available in India (Sharma et al. 2007). The major constraints to popularizing mechanized farming in India are:

- Small land holdings and socio-economic factors;
- Non-availability of suitable machines/implements;
- Problem of unemployment;
- Lack of appropriate knowhow on the use of machines/machinery on their maintenance/upkeep;
- Traditional age-old practices such as row-spacing configurations that make the use of machinery difficult;
- Different sugarcane regulatory acts and rules in different states.

Against this backdrop, IFC has led a partnership with Solidaridad and two sugar companies (DSCL Sugars and Olam Agro India Ltd.) since 2013 to accelerate mechanization in project sites in the states of Uttar Pradesh, Madhya Pradesh and Maharashtra around six mills of the two sugar companies.

**METHODOLOGY AND STRATEGIC APPROACH**

The program has helped create new/strengthen existing rural entrepreneurs as agri-technology service providers (ATSPs) to purchase agriculture equipment/machines and lease them out to farmers on a custom-hire basis. ATSPs are village-based farmers-cum-micro-entrepreneurs. Singh and Singh (2006) summarized that different equipment needs to be procured depending on the good farm practices that need to be promoted. For example before the project, farmers were doing shallow land preparation, resulting in the formation of hard pans, and flat planting in shallow furrows giving lower yield and higher consumption of irrigation water. The project involved promotion of deep ploughing to break the hard pan as well as to facilitate trench planting. Accordingly, ATSPs were advised to procure equipment such as mouldboard plows and trench openers. Similarly, for automatic planting, cutter planters have been introduced. The complete list of equipment promoted includes: mouldboard plow, laser land leveler, trench opener, cutter planter, power tiller, foliar sprayer, trash shredder and mechanized harvester. Competitive prices for equipment are obtained from different suppliers of similar equipment and specifications. Mechanization fairs are organized frequently in the mill districts where the manufacturers of such machines are invited to exhibit useful equipment. Sometimes the manufacturers give handsome discounts for machines sold in these fairs.

The program uses customized training modules to focus on building capacities of ATSPs to better manage their businesses. The India Sugar Program operates in 801 villages (for DSCL sugars) around four mills in Ajabpur (Lakhimpur Khiri district); Loni, Hariawan and Rupapur (Hardoi district) in Uttar Pradesh, 226 villages in Maharashtra (Kolhapur district), and 189 villages in Madhya Pradesh (Barwani district).

The following stepwise approach was adopted to roll out the ATSP model at all project sites:

1. Needs assessment (identification of ATSPs and new activities/machines): The needs or the requirements of services required by each stakeholder are collected by the field extension staff of sugar mills and the needy farmers are connected with the ATSPs. The field staff of the sugar mills are in regular touch with each farmer in connection with various extension services and arranging supply of their sugarcane to the sugar mill. They were advised to nominate such potential and interested rural entrepreneurs. Thereafter, IFC experts conducted interviews and select good ATSPs capable of doing such additional business. They are then trained on various aspects including technical aspects and business.

2. Training of ATSPs (on use and maintenance of machines): Regular training is organized/conducted by equipment manufacturer (facilitated by the project teams). This is also supplemented by refresher training modules and training on overall upkeep and maintenance of the equipment/machines. A few ATSPs provide services to maintain such machines, as well as the suppliers of some of the equipment also are providing aftersales services.

3. Business planning for ATSPs (specifying Return on Interest): Depending on the interest of an ATSP and the type of equipment available with respect to the demand and financial resources to buy new machines, a business plan for each ATSP is developed to utilize his/her available tractor/implements on the maximum days in a year and generate revenue leading to profitability.

4. Identification and introduction of suitable/specific machines: Mentioned in the section above. In addition, the ATSPs provide services to the farmers, i.e. they operate the tractors/equipment. Therefore, the risk lies with the ATSP only. Some machines/equipment such as tractors and mechanical harvesters are insured. Other machines that are worth more than above INR 200,000 such as planters/laser land levelers are optionally insured. New machines/equipment usually have a 3-years guarantee from the suppliers, so there is no issue of risk or insurance.

5. Support/identification of linkages to local banks to arrange funds for buying machines.

6. Capitalization of government funding to strengthen the concept: Government schemes (state) and bank loans have been facilitated for farmers to accelerate the purchase of equipment/machines.

7. Training of mill staff/extension personnel to connect ATSPs with small farmers: Training sessions on the use/operation/maintenance of different machines have been provided to these personnel and they in turn guide/supervise the ATSPs and other farmers on the equipment/machines.
Training of ‘entrepreneur’ farmers was strengthened by an expert organization, the International Centre for Entrepreneurship and Career Development (ICECD), which is a business edge-certified organization. They facilitated the development of robust business cases and ensured the initial ‘hand holding’ and monitoring of ‘success/impact stories’ of entrepreneur-farmers.

**BENEFITS OF THE ATSP MODEL**

**Benefits to farmers**

- Demand-driven and participative approach to good farm practices and innovation in mechanized farming; reducing drudgery and increasing yields;
- Access to better technical know-how, information on government schemes, bank loans, better seeds, crop care, etc. and overall improvement in agricultural skills of the farmer;
- Ease/aid in transaction/processing of paperwork for bank loans, and for hiring and leasing in of agri-farm equipment.

**Benefits to the sugar mills**

- Ease in dissemination of good practices in mechanized farming; cascading effect through ATSPs;
- Improved productivity of agricultural lands and capacity building of mill extension staff;
- Ease in administration as staff hours of extension workers spent on reaching out to farmers directly reduced considerably.

**RESULTS FROM PROJECT SITES**

**DSCL Sugars (Uttar Pradesh)**

Sugarcane farms in Uttar Pradesh are marked by very small land holdings and poor technical know-how among farmers. There has been slow adoption of mechanized farm activities, with the top three activities being land preparation (deep plowing), planting techniques (trench/mechanized) and inter-cultural operations. Table 2 summarises sequentially the activities done on ground to establish the ATSPs.

**Table 2. Major activities in DSCL Sugars for ATSPs.**

<table>
<thead>
<tr>
<th>ATSPs Identified (January to October 2013)</th>
<th>Initial Workshops Conducted (October 2013 to June 2014)</th>
<th>Business Plan Development Facilitation (December 2013 to July 2014)</th>
<th>Active ATSPs (December 2014 onwards)</th>
<th>Financial linkages facilitated (November 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>20</td>
<td>50</td>
<td>35</td>
<td>5 (UDS 19,200 credit mobilized from banks)</td>
</tr>
</tbody>
</table>

**Olam (Madhya Pradesh and Maharashtra)**

Although the farmers in the project areas of Olam in Madhya Pradesh and Maharashtra are very progressive, adoption rates of mechanized farming has been very slow. One of the reasons for this is that the farms are relatively more widely spread as compared to Uttar Pradesh. Hence, logistic support for farm equipment is a challenge in those places. Another reason for the slow penetration of mechanization under the program in these project areas is because income from sugarcane cultivation is supplemented by intercropping, which provides income to hire additional manpower. Table 3 summarises sequentially the activities done on ground to establish the ATSPs in Olam.
Table 3. Major activities in Olam for ATSPs.

<table>
<thead>
<tr>
<th>ATSPs identified (June 2013 to June 2014)</th>
<th>Initial workshops conducted (July 2014 to December 2014)</th>
<th>Business plan development facilitation (July 2014 to December 2014)</th>
<th>Active ATSPs (January 2015 onwards)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>12</td>
<td>35</td>
<td>20</td>
</tr>
</tbody>
</table>

Area covered under mechanization through ATSPs

The major operations in both DSCL sugars and Olam to promote mechanization through ATSPs gave encouraging results in terms of farm areas covered (Table 4). Activities/operations related to land preparation (for e.g. deep ploughing and leveling) and pest management have become more mechanized than other operations.

Table 4. Area covered under mechanization in DSCL Sugars and Olam from 2013.

<table>
<thead>
<tr>
<th>Practice</th>
<th>DSCL (ha)</th>
<th>Olam (ha)</th>
<th>Total (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deep plowing</td>
<td>3,500</td>
<td>6,500</td>
<td>10,000</td>
</tr>
<tr>
<td>Land levelling</td>
<td>1,000</td>
<td>400</td>
<td>1,400</td>
</tr>
<tr>
<td>Trench planting</td>
<td>1,200</td>
<td>1,600</td>
<td>2,800</td>
</tr>
<tr>
<td>Mechanized planting</td>
<td>1,500</td>
<td>500</td>
<td>2,000</td>
</tr>
<tr>
<td>Inter-cultural operations</td>
<td>1,000</td>
<td>200</td>
<td>1,200</td>
</tr>
<tr>
<td>Trash shredding</td>
<td>-</td>
<td>330</td>
<td>330</td>
</tr>
<tr>
<td>Foliar spray</td>
<td>800</td>
<td>2,000</td>
<td>2,800</td>
</tr>
<tr>
<td>Mechanized harvesting</td>
<td>--</td>
<td>1,000</td>
<td>1,000</td>
</tr>
</tbody>
</table>

LESSONS LEARNT

1) Risk profiling of identified entrepreneurs: ATSPs may be identified and created but most ATSPs (60-70%) may fail within 1 year of operation. Therefore, the selection of the ATSPs is a critical process. Farmers, who are already in some kind of rural business, with existing mechanization assets (for example, tractors), are good candidates for ATSPs (as they have made investments and possess some risk-taking capabilities).

2) Participatory planning: Business plans should be developed by ATSPs themselves (for greater ownership). This helps the entrepreneur understand the business and associated economics better. One should NEVER make a business plan and give it to an entrepreneur.

3) Access to finance: Financial linkages for ATSPs are important, but challenging. Involvement of financial institutions at the business plan facilitation stage is helpful.

4) Regular training sessions: Involvement of credible farm mechanization companies to provide technical training to ATSPs is important. This includes safety and maintenance of farm equipment to reduce downtime and improve reliability of the equipment and longevity of the ATSP business.

5) ATSP farmers have reported the lack of timely and adequate availability of operation and maintenance services. In response to this challenge, sugar mills have a dedicated staff to track the progress of work/activities of each ATSP and farmers using the services, so that time lag is minimized and optimum utilization of each equipment/machinery is achieved.

CONCLUSIONS

The ownership of machinery is mainly determined by economic viability linked to the utilization of the equipment/machinery. This led to the development of custom-hiring services through the ATSP model, which has helped the majority of the small holdings take up operations with farm machinery without investing in high-cost machinery. Custom hiring services are better for smaller farmers to avail non-farm employment opportunities. Overall, this model is beneficial for small farmers to
cut down cost of production, enhance yields, and increase net margins. To further strengthen the program, external stakeholders/government agencies may supplement the efficient delivery of custom-hiring services for costly machinery by fixing custom-hiring rates for farm machinery that are dependent on the utilization of the machines/equipment. Ensuring maximum utilization of an equipment/machine makes it most cost effective and the ATSP model a success.

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Sous-traitance au niveau de l’exploitation : promouvoir la mécanisation chez les agriculteurs canniers par le biais de services contractuels personnalisés

Résumé. La pénurie croissante de la main-d’œuvre agricole se pose comme un sérieux défi aux agriculteurs dans leur tentative de compléter les différents travaux aux champs au moment opportun et cela a un impact négatif sur les rendements et la rentabilité. La culture cannière en Inde, étant intensive, nécessite 352 journées de travail par hectare, contre 171 pour le riz et 117 pour le blé. La petite taille des exploitations et le coût élevé des machines sont les raisons principales de la non-adoption de la mécanisation par les paysans. Ainsi, en se basant sur le concept d’une approche axée sur l’entrepreneuriat afin de promouvoir les bonnes pratiques culturelles dans la canne à sucre, l’IFC avec la collaboration de Solidaridad et de deux compagnies sucrières (DSCL Sugar et Olam Agro India Ltd.), a introduit dans le Programme Consultatif de soutien aux agriculteurs canniens en Inde, la formation des prestataires de services d’agrotechnologies (ATSPs) afin d’aider les petits agriculteurs. Les ATSPs sont des agriculteurs/micro-entrepreneurs basés dans les villages qui mettent à la disposition de leurs collègues agriculteurs, en particulier les petits producteurs marginaux, un service personnalisé de location des machines modernes. L’étude comportait des activités clés tels que l’évaluation des besoins, la formation, l’élaboration de plans de travail, l’identification et l’introduction des machines appropriées, la liaison avec les banques locales pour financer l’achat de machines, etc. 71 ATSPs ont été établis. Ces ATSPs ont acquis différents équipements tels que tracteurs, moissonneuses mécaniques, planeuses, charrues profondes, planteuses semi-automatiques, motoculteurs et pulvérisateurs. Cette approche a permis aux petits agriculteurs de compléter les pratiques culturelles améliorées au moment opportun, telles que le labour profond (10 000 ha), le nivellement des terres (1 400 ha), la plantation en tranchée (2 800 ha), la plantation mécanique (2 000 ha), les opérations en intercalaire/le désherbage (1 200 ha), le déchiquetage de pailles (330 ha), la pulvérisation foliaire (2 800 ha) et la récolte mécanique (263 000 t). Il est bien connu qu’avec le support de machines modernes, les rendements et les revenus des exploitations agricoles seront améliorés si ces opérations culturales sont complétées à temps. Il peut être conclu que les ATSPs peuvent mécaniser les pratiques culturelles dans la culture cannière, et même chez les petits agriculteurs.

Mots-clés: Manque de la main-d’œuvre agricole, agriculteurs en tant qu’entrepreneurs, bonne gestion des exploitations
Externalización de procesos de granja: promoción de la mecanización entre los agricultores de caña de azúcar a través de los servicios de proveedores de servicios agro-tecnológicas personalizadas-alquiler

Resumen. Con la creciente escasez de mano de obra agrícola, completando diversas prácticas agrícolas en el tiempo se está convirtiendo en un grave problema que está afectando negativamente a los rendimientos agrícolas y la rentabilidad. En la India, el cultivo de la caña de azúcar es altamente dependiente de trabajo y de cultivos requiere 352 días de trabajo por hectárea, en comparación con 171 para el arroz y 117 para el trigo. La mecanización no está siendo adoptado principalmente debido a las pequeñas explotaciones y porque los agricultores no pueden permitirse máquinas. Por lo tanto, basado en el concepto de la promoción de un enfoque dirigido por el espíritu empresarial a través de buenas prácticas agrícolas en el cultivo de la caña de azúcar, la CFI (en colaboración con Solidaridad y dos empresas azucareras (DSCL Azúcares y Olam Agro India Ltd.)), con el apoyo de la India Azúcar Asesor Los agricultores Programa, incluido como un componente, el desarrollo de proveedores de servicios de Agri-Tecnología (ATSP) para facilitar de retención de los pequeños agricultores. ATSP están basadas en las aldeas los agricultores con los microempresarios que proporcionan acceso a las máquinas modernas para otros agricultores, en particular los productores pequeños y marginales, de forma personalizada de alquiler. El estudio incluyó actividades clave como la evaluación de las necesidades, la formación, la preparación de planes de negocio, identificación e introducción de máquinas adecuadas, los vínculos con los bancos locales de fondos para comprar máquinas, etc. Se han establecido 71 ATSP. Estos ATSP han adquirido diferentes máquinas agrícolas como tractores, cosechadoras mecanizadas, niveladores tierra, arados profundos, jardineras semi-automáticas, motocultores y rociadores de la energía este modelo ha facilitado a las prácticas agrícolas mejoradas a tiempo completo a los agricultores de pequeñas propiedades tales como el arado profundo (10,000 ha), nivelación de tierras (1,400 ha), la siembra zanja (2,800 ha), siembra mecanizada (2,000 ha), intercultural operaciones / escarda (1,200 ha), la trituración de basura (330 ha), pulverización foliar (2,800 ha), mecanizada recolección (263.000 t). Se está bien establecido que la terminación oportuna de estas prácticas agrícolas que utilizan máquinas modernas mejora el rendimiento y aumenta los ingresos agrícolas. Se puede concluir que la mecanización del cultivo de la caña de azúcar, incluso en campos pequeños agricultores, es posible a través de ATSP.

Palabras clave: Escasez de mano de obra agrícola, los agricultores como empresarios, buen manejo agrícola general