



International Journal of Agricultural Economics and Farm Management

Journal homepage: <https://trpub.org/journal.php?id=4qPpz5AHAZ>

TRPub

IJAEFM

International Journal of
Agricultural Economics
and Farm Management

Vol. 1 Issue 1 2026

Methodology Article

Open Access

Planning Cooperative Custom Hiring Centres for Farm Machinery in the Indo-Gangetic Plains: A Methodological Framework

Bruno Melo^{1*}, Sona Zielinski², Kebede Petrovic³

¹Department of Agri, Pampas University Centre for Agri, Thailand

²Department of Agri, Skagerrak Institute of Agri, Brazil

³Department of Agri, Hejaz University Centre for Agri, Croatia

Article Info

Volume 1, Issue 1, 2026

[doi: 10.62715/ijaefm.2026.v1.i1.pp14-19](https://doi.org/10.62715/ijaefm.2026.v1.i1.pp14-19)

Received: 16 November 2025

Accepted: 04 January 2026

Published: 26 February 2026

Abstract

Small farms in the Indo-Gangetic Plains cannot each justify a tractor, a seed drill and a combine, yet the rice-wheat calendar leaves only a short interval in which land must be cleared and the next crop sown. Custom hiring centres, which own machines and sell their services by the hour or the hectare, are the policy response, and cooperatives are among the bodies encouraged to run them. Many such centres are equipped according to the subsidy on offer and not according to the work to be done, with machines that stand idle or that cannot serve members on time. This article proposes a seven-step framework for planning a cooperative centre: define the service area, estimate the work by time window, size the fleet from field capacity and workable days, cost each service, set charges and booking rules, establish governance and operator arrangements, and monitor utilisation. Each step draws on standard machinery management methods and on the literature on mechanisation service markets and cooperative governance, and each is described with the information it needs and the output it should produce. The framework is a proposal. It has not been applied or validated here, and the article sets out what a field test would need to establish.

Keywords: Custom hiring, Farm mechanisation, Machinery cooperatives, Rice-wheat system, Machinery management, Timeliness

© 2026 Bruno Melo et al. This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

1. Introduction

Farm power in South Asia has shifted from animals and hand labour to engines within two generations, and it has done so largely through hiring. Farm machines are indivisible, and a holding of one or two hectares cannot use a tractor or a combine for more than a few days a year. Where such farms have mechanised, it is because owners of machines sell services to their neighbours (Binswanger, 1986; Pingali, 2007). Pump sets, threshers, power tillers and four-wheel tractors all spread in this way, through markets for services that planners did little to design.

Private hiring does not reach every farmer or every operation. Owners serve their own land first, and

* Corresponding author: Bruno Melo, Department of Agri, Pampas University Centre for Agri, Thailand. E-mail: bruno.melo@pampas.edu

specialised machines with a short season, such as zero-till drills, are slow to attract private investment. Indian policy has therefore supported custom hiring centres and farm machinery banks with capital subsidies, and has named cooperatives and farmer groups among the eligible operators ([Government of India, 2014](#)). A centre owned by its users promises service at cost and priority for members who would otherwise wait at the back of a private owner's queue.

Whether the promise is kept depends on decisions taken before any machine is bought: which operations to serve, how many machines of what size, what to charge and how to ration service at peak times. This article proposes an ordered procedure for those decisions. It is written for cooperative managers, promoting agencies and lenders. It reports no application to an actual centre, and the reasoning behind each step is drawn from published methods.

2. Background

The framework rests on three bodies of knowledge: the economics of machinery hire, the agronomy of the rice-wheat calendar and the theory of cooperative governance.

2.1. Hire markets and their limits

Service markets allow machine capacity to be matched to many small plots, and in China they have grown to the point where combine teams follow the harvest across provinces ([Yang et al., 2013](#)). The same literature records failures of supply-led models. In Ghana, state-supported mechanisation centres equipped with large tractors struggled to achieve the utilisation needed to cover their costs, while private owner-operators serving neighbours expanded ([Diao et al., 2014](#)). Hiring also has an inherent weakness for time-critical work. Every farmer in a locality wants the same operation in the same fortnight, and a farmer who hires bears the cost of waiting, which is one reason farmers who can afford it prefer to own ([Allen and Lueck, 2002](#)). Rental frictions of this kind help explain why machine capacity and farm size remain poorly matched ([Foster and Rosenzweig, 2022](#)).

2.2. The rice-wheat calendar

The dominant rotation of the plains places a wet-season rice crop before a winter wheat crop, with a turnaround that is short everywhere and shortest where long-duration rice is grown ([Timsina and Connor, 2001](#)). Wheat sown after its optimum date loses yield as grain filling is pushed into rising spring temperatures, a relationship established experimentally for north-west India ([Ortiz-Monasterio et al., 1994](#)). Zero tillage, in which wheat is drilled directly into rice stubble, shortens the turnaround and lowers cultivation costs, and its spread in the region has depended on service providers who own the drill ([Erenstein and Laxmi, 2008](#); [Keil et al., 2016](#)). Timeliness is therefore the main product that a hiring centre sells in this system, and capacity planned on annual averages will fail at the moment it is needed.

2.3. Cooperative ownership

Jointly owned machinery is a shared resource with familiar hazards. Members have an incentive to use a machine hard and maintain it little, to demand priority at the peak, and to resist charges high enough to replace the fleet. [Cook \(1995\)](#) classified these as free-rider, horizon and control problems in cooperatives generally. [Ostrom \(1990\)](#) found that groups managing shared resources successfully had clear membership boundaries, rules matched to local conditions, monitoring by the users themselves and graduated sanctions. A machinery centre needs each of these in operational form.

3. The Proposed Framework

The framework has seven steps, taken in order and repeated each year. Table 1 lists the information each step requires and what it should produce, and Figure 1 shows the sequence with its annual review loop. The steps are then described one by one.

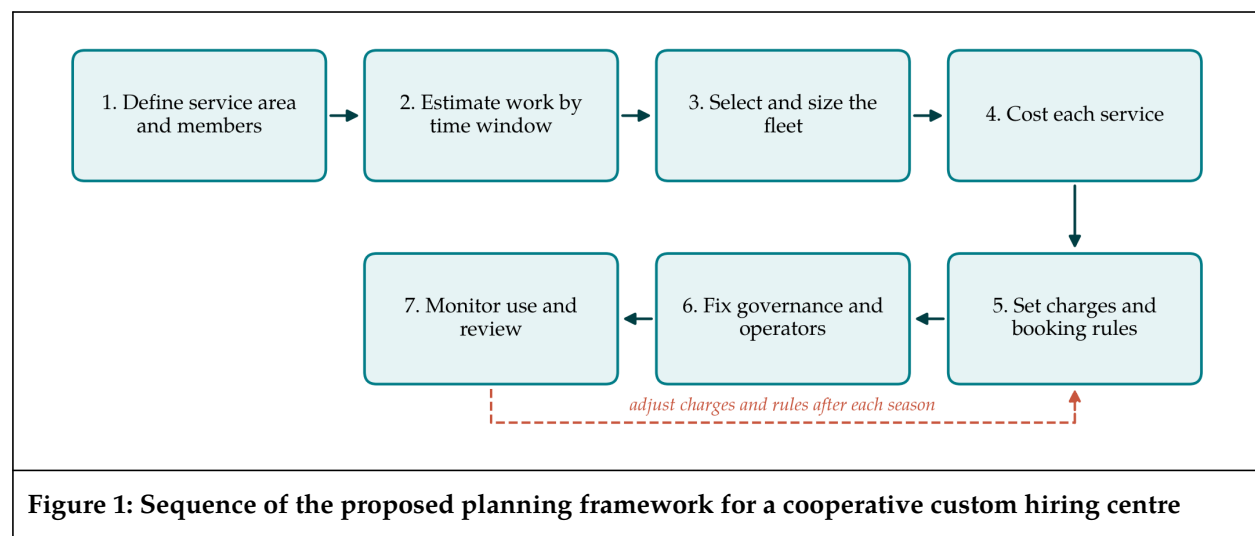
3.1. Step 1: Define the service area and membership

The centre should begin from a register of the members it will serve, with the area each cultivates, the crops grown and the location and access of plots. Travel between scattered plots consumes machine time

that earns nothing, so a compact area served well is preferable to a wide one served late. The register also settles in advance who is entitled to member rates and priority, which is the boundary condition on which the later rules depend.

Table 1: Steps of the proposed planning framework, the information each needs and the output it produces

Step	Information needed	Output
1. Service area and members	Member list, holdings, plot access, cropping pattern	Map and register of area to be served
2. Work by time window	Crop calendar, operations per crop, workable days	Hectares per operation in each window
3. Fleet selection and sizing	Field capacity of candidate machines, tractor power	Number and size of each machine
4. Costing	Purchase prices, subsidy, fuel, repairs, wages, interest	Cost per hour and per hectare; break-even use
5. Charges and booking	Costs from step 4, local private hire rates	Tariff, booking and priority rules
6. Governance and operators	By-laws, available operators and mechanics	Roles, logbooks, maintenance fund, audit
7. Monitoring and review	Logbooks, accounts, service requests not met	Annual utilisation report and revised plan



3.2. Step 2: Estimate the work in each time window

For each crop the operations to be offered are listed, such as primary tillage, puddling, sowing, spraying, harvesting, threshing and residue handling, together with the calendar window in which each must be completed. Multiplying the members' crop areas by the operations gives the hectares of work falling in each window. The number of days within a window on which fieldwork is actually possible is smaller than the calendar length, because of rain, wet soil and breakdowns, and should be estimated conservatively from local experience (Witney, 1988).

3.3. Step 3: Select and size the fleet

Machinery management texts give the effective field capacity of an implement, in hectares per hour, as forward speed in kilometres per hour multiplied by working width in metres and by field efficiency, divided by ten (Hunt, 2001; ASABE, 2006). Typical ranges of speed and field efficiency for each class of machine are tabulated in the engineering standards (ASABE, 2011). The number of units required for an

operation is the hectares to be covered in its window divided by the product of field capacity, working hours per day and workable days. The calculation is made for the tightest window, which in this system is usually wheat sowing, and tractors are then matched to the implements they must pull. Machines that serve several operations or seasons deserve preference, because annual use is what spreads fixed cost.

3.4. Step 4: Cost each service

Ownership costs comprise depreciation, interest on the capital invested, insurance and housing. They accrue whether or not the machine works. Operating costs comprise fuel, lubricants, repairs and maintenance, and the operator's wage. Standard procedures estimate each from purchase price, expected life and annual hours (ASABE, 2006; Hunt, 2001). Costing should be done twice, at the subsidised price the cooperative pays and at the full price that replacement will eventually require. Dividing annual ownership cost by the margin between the hire charge and the operating cost per hour gives the break-even hours of use, the single most informative number for judging whether a machine belongs in the fleet.

3.5. Step 5: Set charges and booking rules

Charges should recover full cost at the utilisation expected from step 2, and should be compared with local private rates. A charge far below the private rate invites excess demand and resale of the service, and one above it loses members. Rules for the peak matter as much as the tariff. Options include serving bookings in order of receipt with a deposit, rotating priority among hamlets from year to year, or capping the area any one member can book in the first days of a window. Service to non-members at a higher rate can raise utilisation outside the peak without displacing members during it.

3.6. Step 6: Establish governance and operator arrangements

Each machine needs a named operator, a logbook recording hours, area, fuel and the member served, and a schedule of routine maintenance. Operators paid partly by the area completed and held responsible for avoidable damage have reason to work quickly and carefully. A fixed share of every hire charge should go to a maintenance and replacement fund that the committee cannot divert to other uses. Logbooks and accounts should be open to members and examined annually by someone outside the committee, which gives practical effect to the monitoring that Ostrom (1990) identified as a condition of durable collective management.

3.7. Step 7: Monitor utilisation and review

At the end of each season the hours worked by each machine are compared with its break-even hours, and requests that could not be met on time are counted alongside them. A machine that falls well short of break-even is a candidate for sale or for wider hiring out, and unmet requests in a window indicate where capacity should be added. The plan for the following year is revised accordingly.

4. Fitting the Framework to Local Conditions

Conditions differ sharply along the plains. In the north-west, holdings are larger, tractor ownership is widespread and combine harvesting is general, so a cooperative centre adds most by supplying specialised equipment for residue management, direct seeding and land levelling that individual owners lack. In the eastern plains, holdings are smaller and more fragmented, private service providers are fewer, and a centre may need to offer basic tillage and sowing as well (Keil et al., 2016). Evidence from Bangladesh indicates that machinery adoption follows infrastructure and access to credit as much as farm characteristics (Mottaleb et al., 2016), which implies that the same plan will perform differently where roads, repair services and fuel supply are weak. A centre in such a location may need to hold its own stock of spares and train its own mechanic.

The framework should also be applied with the private market in view. A cooperative centre that duplicates services already supplied competitively by local owners will struggle for work. One that fills gaps, or that restrains hire rates where a single owner dominates, has a clearer reason to exist.

5. Limitations and What Remains to Be Shown

The framework is proposed and has not been validated here. Its engineering components are standard, but the field efficiencies and repair costs published in the standards derive mostly from larger farms in other regions, and their fit to small, irregular plots in the plains needs checking against logbook data. The governance provisions are inferred from general principles. Which booking rule members regard as fair, and whether a ring-fenced replacement fund survives a poor season, are empirical matters. A useful test would follow centres planned in this way for several seasons and record utilisation against break-even, timeliness of sowing for members, the state of the replacement fund and the distribution of service across small and large members.

Two wider limits should be stated. The procedure takes the cropping pattern as given, although the availability of machines may itself change what members grow. It also treats subsidy as a parameter and does not ask whether subsidised cooperative ownership is a better use of public money than support for private service providers, a question on which the comparative literature is divided (Diao *et al.*, 2014).

6. Conclusion

A cooperative custom hiring centre is a small business selling timeliness to its owners, and it should be planned as one. The seven steps proposed here move from the work to be done, through the fleet and its costs, to the rules that govern who is served and how the machines are kept. None of the steps is new in itself. The contribution is to place established machinery management calculations and principles of collective governance in a single sequence that a promoting agency can follow and a lender can check. The framework now needs to be tried, and its results reported, before it can be recommended as more than a reasoned proposal.

Conflict of interest

To be declared by the author(s) before publication.

Funding

To be declared by the author(s) before publication.

References

- Allen, D.W. and Lueck, D. (2002). [The Nature of the Farm: Contracts, Risk, and Organization in Agriculture](#). MIT Press, Cambridge, MA.
- ASABE (2006). [ASAE EP496.3: Agricultural machinery management](#). American Society of Agricultural and Biological Engineers, St. Joseph, MI.
- ASABE (2011). [ASAE D497.7: Agricultural machinery management data](#). American Society of Agricultural and Biological Engineers, St. Joseph, MI.
- Binswanger, H. (1986). [Agricultural mechanization: A comparative historical perspective](#). *World Bank Research Observer*, 1(1): 27-56. <https://doi.org/10.1093/wbro/1.1.27>
- Cook, M.L. (1995). [The future of U.S. agricultural cooperatives: A neo-institutional approach](#). *American Journal of Agricultural Economics*, 77(5): 1153-1159. <https://doi.org/10.2307/1243338>
- Diao, X., Cossar, F., Houssou, N. and Kolavalli, S. (2014). [Mechanization in Ghana: Emerging demand, and the search for alternative supply models](#). *Food Policy*, 48: 168-181. <https://doi.org/10.1016/j.foodpol.2014.05.013>
- Erenstein, O. and Laxmi, V. (2008). [Zero tillage impacts in India's rice-wheat systems: A review](#). *Soil and Tillage Research*, 100(1-2): 1-14. <https://doi.org/10.1016/j.still.2008.05.001>
- Foster, A.D. and Rosenzweig, M.R. (2022). [Are there too many farms in the world? Labor market transaction costs, machine capacities, and optimal farm size](#). *Journal of Political Economy*, 130(3): 636-680. <https://doi.org/10.1086/717890>

- Government of India (2014). [Sub-Mission on Agricultural Mechanization: Operational Guidelines](#). Department of Agriculture and Cooperation, Ministry of Agriculture, New Delhi.
- Hunt, D. (2001). [Farm Power and Machinery Management](#). 10th edition. Iowa State University Press, Ames.
- Keil, A., D'souza, A. and McDonald, A. (2016). [Growing the service economy for sustainable wheat intensification in the Eastern Indo-Gangetic Plains: Lessons from custom hiring services for zero-tillage](#). *Food Security*, 8: 1011-1028.
- Mottaleb, K.A., Krupnik, T.J. and Erenstein, O. (2016). [Factors associated with small-scale agricultural machinery adoption in Bangladesh: Census findings](#). *Journal of Rural Studies*, 46: 155-168. <https://doi.org/10.1016/j.jrurstud.2016.06.012>
- Ortiz-Monasterio, J.I., Dhillon, S.S. and Fischer, R.A. (1994). [Date of sowing effects on grain yield and yield components of irrigated spring wheat cultivars and relationships with radiation and temperature in Ludhiana, India](#). *Field Crops Research*, 37(3): 169-184.
- Ostrom, E. (1990). [Governing the Commons: The Evolution of Institutions for Collective Action](#). Cambridge University Press, Cambridge.
- Pingali, P. (2007). [Agricultural mechanization: Adoption patterns and economic impact](#). *Handbook of Agricultural Economics, Volume 3 (R. Evenson and P. Pingali, eds)*, Elsevier, Amsterdam, 2779-2805. [https://doi.org/10.1016/S1574-0072\(06\)03054-4](https://doi.org/10.1016/S1574-0072(06)03054-4)
- Timsina, J. and Connor, D.J. (2001). [Productivity and management of rice-wheat cropping systems: Issues and challenges](#). *Field Crops Research*, 69(2): 93-132. [https://doi.org/10.1016/S0378-4290\(00\)00143-X](https://doi.org/10.1016/S0378-4290(00)00143-X)
- Witney, B. (1988). [Choosing and Using Farm Machines](#). Longman Scientific and Technical, Harlow.
- Yang, J., Huang, Z., Zhang, X. and Reardon, T. (2013). [The rapid rise of cross-regional agricultural mechanization services in China](#). *American Journal of Agricultural Economics*, 95(5): 1245-1251. <https://doi.org/10.1093/ajae/aat027>