

What Incentives Do Farmers Need to Stop Biomass Burning? – Examining the Results from a Reverse Auction Study from Nepal

In southern Nepal, it is common practice to dispose crop residue (such as rice straw) by burning it in the field. This causes many environmental problems because biomass burning contributes to smoke, black carbon and greenhouse gases. To try and find a solution to this challenge a SANDEE study from Nepal has looked at what incentives might stop farmers from burning their rice straw. The study is the work of Krishna Prasad Pant, from the Economic Development and Policy Analysis Centre in Kathmandu.

This Brief discusses how a reverse auction was used to identify how much farmers would need to be paid to stop burning. Through a field experiment, farmers were incentivized with an average payment of NPR 5,592/ha to encourage them to stop burning straw. More than 86 percent of the farmers who agreed to accept these payments, stopped rice straw burning for a season. Thus, payment mechanisms can be an effective way to induce behavioural change and reduce environment impacts even in rural areas of the developing world.

The Biomass Burning Problem

In Asia, crop residue accounts for nearly one-third of the total biomass that is burnt. As well as having regional and global impacts, biomass burning also has a number of local impacts, for example, it causes health problems due to smoke and ash. Nepal produces 19 million metric tons of agricultural residue annually. Three crops - rice, wheat and maize - account for more than three-fourths of the total amount of residue produced.

Nepalese farming is dominated by smallholders and residue burning is a traditional practice. Farmers mainly burn to reduce the labour costs of preparing their fields for the next crop. While it is clear that policies are necessary to control this burning, the development of any such policies requires a clear understanding of the additional costs that farmers would incur if they stopped burning.

“Straw burning is far better than non-burning. Not burning the straw creates problems in planting the next crop”, a 60 year old farmer from Aviraw village. But, a 75 year old farmer from the same village has a different view *“Burning straw kills insects and is a sin religiously”*. Nonetheless, most farmers in Nepal burn their crop residue to ready their fields for the next crop.

Assessing Rice Straw Burning in the Southern Terai

The reverse auction was conducted in two districts in the southern Terai of Nepal, Kapilvastu and Rupandehi, where rice straw residue burning is widespread. Of the 85 villages where this practice prevails, 18 were selected for farm-level analyses.

The specific objectives of the study were to assess on-farm utilization, marketing and burning of rice straw by farmers and to determine the level of incentives required to stop rice straw burning in the field.

The Reverse Auction Approach

In a traditional auction, a seller invites bids for a product or service from prospective buyers and sells to the highest bidder. This type of auction is called a sales auction. In contrast, in a reverse auction, several sellers offer their goods or services and compete for a price that is acceptable to the buyer. The buyer generally accepts the lowest bid that meets a set minimum standard. In this study, farmers competed on how much they could be paid to not burn a fixed quantity of their farmland.

The reverse auction is a particularly appropriate mechanism for addressing specific market failures in conservation that involve privately owned land. This is because this type of auction can allocate conservation services to the lowest bidders. Thus, it results in services being provided for the least cost.

The study used a uniform price auction (UPA), where all participants are paid at the same rate of payment irrespective of their bid amount. This is considered a suitable strategy for use among smallholder farmers. The payment in a UPA can either be the rate of the lowest losing bid or the highest winning bid. Payment at the rate of the lowest losing bid (which was the approach taken by the study) motivates the bidders to make a bid based on the true costs.

In the context of the study this is because farmers cannot gain by bidding higher than their true costs since the price they receive is independent of their bid. They may therefore lose out by bidding above their true costs. On the other hand, they cannot gain by bidding below their true costs since, if they win as a result, the amount they would receive would not cover their costs. Thus, as long as farmers are aware of their true costs (and have had some practice in the auction process), this method can be expected to reliably elicit the actual costs of not burning.

It is important to understand that burning is the cheapest option for farmers to get rid of their rice straw residue. It is also important to note that burning and the other residue management techniques bring a range of benefits (such as soil fertility and pest control). Thus, the minimum amount of money that a farmer will be willing to accept to stop burning straw is expected to be the difference between the private net benefit of burning and the net benefit from any alternative management strategy.



Open field burning of rice straw in Rupandehi

Using a Reverse Auction to Examine Incentives

Using a reverse auction approach (see side bar for details), farmers were asked how much at the minimum they would be willing to accept to stop burning their largest paddy field in the following season. This auction was first carefully publicised through door-to-door visits and through a farmers' information meeting held in each study village. Each farmer was then provided with a bid form and asked to put down a bid for the amount he or she should be paid (per unit of land) for not burning straw.

Each participating village had a specific cut-off point for choosing farmers who would take part in the field experiment (of not burning straw). All the bids on or above the cut-off point were rejected, i.e., only farmers who were willing to accept less than the cut-off bid were invited to be part of the experiment. The cut-off point itself was the bid amount that would ensure that the total payment made to all participants in a village was close to a previously identified village budget.

The Basic Problem of Burning

A baseline survey conducted amongst farmers who participated in the auction shows that rice straw burning is the dominant practice in this area – nearly 96 percent of the farmers burnt their rice straw in open fields while about 2 percent used it as cooking fuel. Since only a few farmers had livestock, less than 9 percent of the farmers used rice straw as animal feed.

Figure 1 shows that the primary reason that farmers burned their rice straw was because it was the most convenient way to prepare land for the following season. The survey also showed that the level of straw burning increased when a machine, called the combine harvester, was used for harvesting rice.

The Reverse Auction Results

In all, 317 farmers from 18 villages participated in the reverse auction. The area of the plots under the auction ranged from 0.28 ha to 0.80 ha. The average bid amount in the villages varied from NPR 2,896/ha to NPR 24,069/ha.

The average cut-off point across the 18 villages was NPR 5,592/ha with the median at NPR 5,610. Out of the 317 farmers who participated in the auction, 167 farmers presented bids that fell below the cut-off points. Thus, these 167 farmers were selected for the experiment.

Factors that Affected the Bid Amount

Farmers' bids vary because the costs that they might incur in implementing alternative straw management practices instead of burning also vary based on different management techniques. Generally, such costs are dominated by the labour required in using alternate techniques.

Pant used a statistical approach to identify the different factors that affected the amount farmers bid. His analysis shows that the direct cost of alternative straw management is not the only factor that affects farmers' decisions. Socio-economic and cultural factors, such as plot size, education, ethnicity, the practice of joint decision making and the amount of straw produced, are also important.

An important finding is the direct and positive relationship between every hectare increase in a farm plot size and the bid amount. This is explained by the fact that the larger the plot size, the more difficult it would be for farmers to manage rice straw using family labour and the larger their out-of-pocket labour expenses in hiring labor. The study finds that the amount of land that farmers in a village would be willing to enrol in an anti-burning programme increases proportionately with the increase in the rate of the payment.

The Field Experiment

To start the study's field experiment, each of the 167 participants signed individual agreements before the harvesting season in October 2010. These agreements stated that they would be paid an agreed amount only if they did not burn rice straw in the plot for which they had made their bid. Farmers agreed to have their rice straw management activity monitored by village youth on a weekly basis. GPS tracking was used for field verification at the end of the burning season.

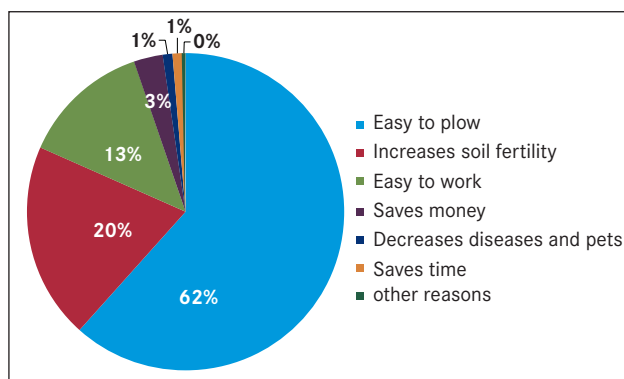


Figure 1: Reasons for burning rice straw (Percent of surveyed farmers who said 'yes')

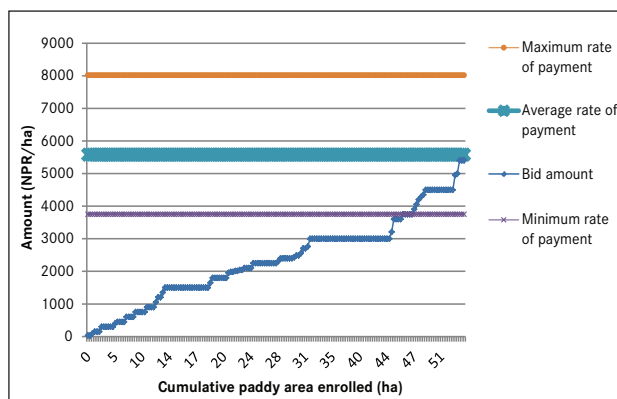


Figure 2: Comparison of Rate of Payment with Bid Amount (the supply curve)



Baseline survey in progress in Rupandehi district

In the subsequent experiment, all participants from each village were paid a uniform rate. This was equivalent to the lowest bid amount from those bids that had been rejected. This meant that every experiment participant got a payment that was higher than his or her bid. The average payment made through the auction was NPR 5,592/ha. Payments varied by village.

How the Farmers Performed

The field monitoring and verification showed that 86 percent of the farmers who signed an agreement complied and did not burn the straw in the field. The agreed amount of cash was then paid to all 144 compliant farmers during the first week of January 2011.

SANDEE

The South Asian Network for Development and Environmental Economics (SANDEE) is a regional network that seeks to bring together analysts from the different countries in South Asia to address their development-environment problems. Its mission is to strengthen the capacity of individuals and institutions in South Asia to undertake research on the inter-linkages among economic development, poverty, and environmental change, and to disseminate practical information that can be applied to development policies. SANDEE's activities cover Bangladesh, Bhutan, India, Nepal, Pakistan, and Sri Lanka.

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The main way in which compliant farmers avoided the need to burn their rice straw was by incorporating it entirely into the ground by ploughing (see Figure 4). A fourth of the participating group also collected and used the top part of the straw for fodder and incorporated the remaining stubble into the soil.

In all, 23 farmers (or 14 percent) breached the agreement and burnt their rice straw. When asked why they did this, nearly 22 percent of them cited a shortage of labour as the main reason, though some others reported a lack of time. Burning was also done inadvertently. Significantly, none of the 'non-compliant' farmers said that the level of payments was the reason for non-compliance.

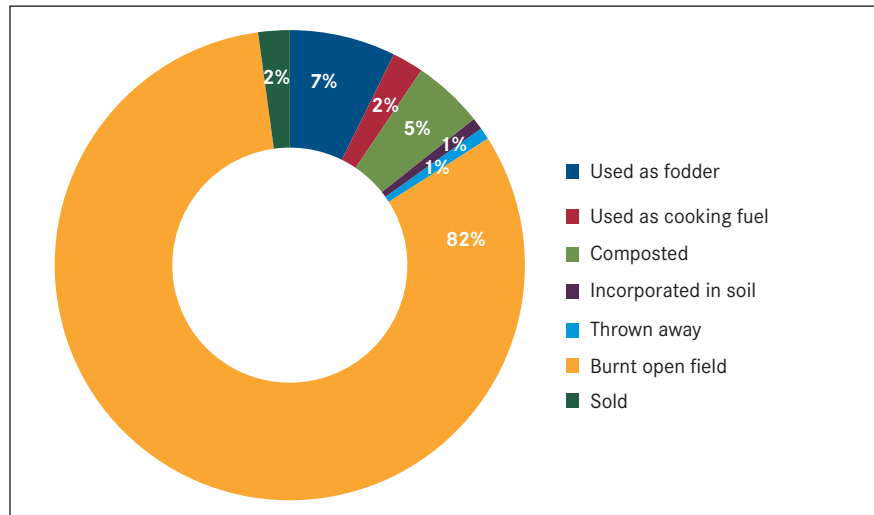


Figure 3: Pre-agreement use of straw (% participating farmers saying 'yes')

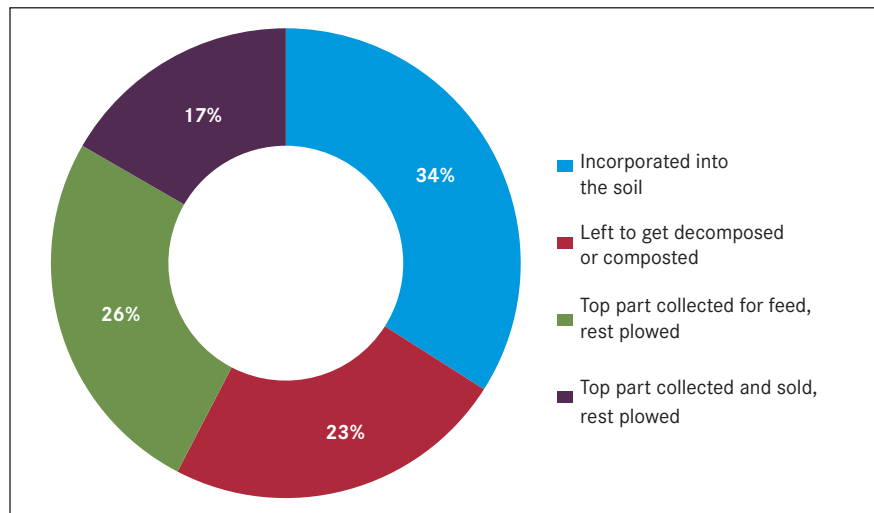


Figure 4: Post-agreement use of straw (% compliant farmers saying 'yes')

Conclusions and Policy Recommendations

The study highlights the fact that many factors affect farmers' willingness to avoid burning. However, the main conclusion is that a payment mechanism can be effectively used to stop small-scale farmers from burning rice straw stubble and other biomass. Incentive schemes, however, are not easy to implement and there may be institutional barriers to implementation that need further scrutiny.

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