Management of community grain stocks in dryland areas of Andhra Pradesh, India

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Abstract

In Indian villages, many households rely for their food security on the government sponsored Public Distribution System (PDS) that offers relatively poor quality rice or wheat at low prices. However, even in the medium term, the cost of public sector grain management to ensure food security is unsustainable. For this reason, central and state authorities in India have encouraged research into policy and practical guidelines for village-level food security. The approach being tested is to develop grain banks with groups of landless women in dryland areas of Andhra Pradesh where the cereal staple is sorghum. These self-help groups are formed with the help of a local NGO. The research partners in this exercise are seeking to understand the situation, characteristics and needs of the village communities, recognising that any initiative in community storage should be developed through a process in which demand is established and the way of working elaborated within the Group. The sustainability of this approach will become apparent over next few years. The strong emphasis on Group formation and the development of appropriate systems by the Group itself should encourage a high degree of 'ownership' and give a greater chance of success than experienced with grain banks in the Sahel since the 1970s.

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1. Introduction

In Indian villages, many households have to rely for their food security on the government sponsored Public Distribution System (PDS) that operates through Fair Price shops. These offer relatively poor quality rice or wheat at low prices to those people entitled to such provision. However, even in the medium term, the cost of public sector grain management to ensure food security is unsustainable. For this reason, central and state authorities in India have encouraged research into policy and practical guidelines for village-level food security. The advantages of decentralised grain storage are that it offers poor people access to food and it links poor farmers to the grain market so enhancing livelihoods.

The approach being tested is to develop grain banks with groups of landless women in dryland areas of Andhra Pradesh where the cereal staple is sorghum. Sorghum is rarely if ever used in the PDS as it is claimed to have a short shelf-life. The self-help groups are formed with the assistance of an NGO, the Centre for Environment Concerns (CEC). The research partners in this exercise are seeking to understand the situation, characteristics and needs of the village communities, recognising that any initiative in community storage should be developed through a process in which demand is established and the way of working elaborated within the Group. This is especially important in view of the past history of grain banks in other parts of the world. For example, the formation of cereal banks began in the Sahel in the 1970s but by the 1990s

of the four thousand or so banks that had been formed the majority were no longer functional (Günther and Mück, 1995). It was not clear whether the causes of failure were inherent within the system or could have been resolved by better management systems. Nevertheless, India has had successful community grain storage in various parts of the country but most of these appear to have fallen into disuse as better communications lead to greater reliance on markets.

Besides the formation of effective groups, another important element in the establishment of communal grain management is that the stock can retained with minimal quality decline during the period that the Group require it for their own food security. The grain will either be consumed or, if in excess, sold on the local market when prices have risen sufficiently. In the case under study, the sorghum crop is rain-fed and cultivated during the kharif season that yields a crop in October just after the end of the monsoon. It would normally remain in store until the start of the next monsoon in June. This implies a maximum storage period of about 9 months.

2. Group Formation

CEC's work with women's self-help groups (mahila sangham) started in early 1994 in Mirzapur village, where a women's group was established with 33 members. In the initial period they faced opposition from outside and within their own households. Landlords in the village warned them not to form a group, threatening that they would not employ them in their fields. The women, however, resolved to form the Group and in a short time won the support of their family members and could withstand the pressures of the landed owners.

The first programme in Mirzapur was a savings scheme where each member of the Group contributed Rs. 5 (1 Indian rupee = 0.02 US$). However, it was the food security related issues that caught their attention. Due to lack of capital some of the land owned by the members of the Group was lying fallow. With financial and organisational help from CEC, group members put the fallow lands under cultivation. This led to increased availability and accessibility of food grain, particularly sorghum. This endeavour, besides improving food security, gave experience and confidence in group working. The Group successfully bargained with different service providers like tractor owners/operators, grain traders etc. In 1996, 36 acres of fallow land was brought under cultivation, which rose to about 100 acres in 1999, and 110 acres in 2000.

The experience and confidence gained in cultivating their own fallow land suggested that they could lease and cultivate the fallow lands of others in their village. Accordingly, CEC facilitated the cultivation by women's groups of land leased from other farmers. In the first year, the women took out a two-year lease on 12 acres of land, at a cost of US$ 380. This was financed in part by CEC and in part by the savings of the Group. At present the Women's Group is cultivating 22 acres of leased land.

Those women belonging to the Group who work on the leased land earn wages – in cash for weeding and in grain for harvesting – and also get a share in the grain distributed by the Group. Money from the sale of grain in the local market is used to repay loans taken from CEC.

The Group is responsible for all major decisions in relation to the cultivation of fallow lands although where the land already belongs to individual members they cultivate it whereas leased land is operated by the Group as a whole.

3. Grain storage

Grain produced by the fallow land programme was stored in the individual members' households and was meant to be given on loan to the members during the lean season. Storage of such large quantities of grain posed a problem. When they stored the grain in bags, they lost around 20% due to rodents, insect pest attack and dampness during rainy and winter seasons, despite their best efforts at protection. Improved storage facilities were clearly needed and after discussions with CEC and IGSM & RI and visits to neighbouring villages that had storage bins, they decided to construct a 13.0 tonne capacity reinforced cement concrete bin. This was completed in 2000 ready for the storage of kharif sorghum. The Group also bought and stored sorghum produced on lands leased by a Group in the neighbouring village of Malkapur, as well as that produced on the land taken up under the fallow land regeneration programme in Mirzapur. The total came to 6.4 tonnes, about half of which was distributed in August and September of 2001, and the rest sold to CEC for distribution in the drought-hit district of Nalgonda. While ownership and control of the community bin rests with the Women's Group, operations are managed by a five-member "Food Security Committee" which holds weekly meetings with the Group.

The concrete bin constructed in Mirzapur in 2000 cost nearly US$ 720 and costs nearly US$ 220 to operate annually, which includes the transport and boarding costs of CEC and IGSM & RI staff who supervise the quality and operation of the bin.

The members are happy with the location and size of the bin. They felt that it was better to have one that may be too big than one that might prove too small. But they are unhappy about certain other features of the bin, in particular

- The lack of a partition: They now feel that it would have been better to have a partition in the middle to hold sorghum harvested in the kharif and rabi seasons separately.

- The heaviness of the lid: They have found the concrete lid too heavy. Several women have hurt their fingers and hands trying to open it.

- Pest infestation due to moisture: Moisture seeping in via outlet port appears to be responsible for pest infestation. The present outlet was not fitted properly and the cement plastering was inadequate. Small quantities of rainwater settles near the outlet causing dampness that favours pest growth.

These problems were discussed with the staff of IGSM & RI. It has not proved possible to insert a partition into the bin but the heavy concrete lid has been replaced by one constructed of fibreglass and necessary repairs have been made to the outlet to prevent moisture ingress.

4. Methods of pest management currently in use

After placing the stock in the silo, the stock is periodically inspected for presence of insect pests. Samples are drawn by hand from the top layer by a person entering the silo through the top hatch and also from the bottom through the outlet. The samples are inspected for presence of insect pest. If insects are found in the stock, fumigation with

aluminum phosphide tablets is undertaken (dosage – 2 tablets per cubic meter and exposure period of 7 days) under the supervision of IGSM & RI. Re-occurrence of insect infestation was noticed 3 months after the first treatment requiring a second fumigation. Adequate measures have been taken to make the outlet reasonably airtight, thus giving no room for the insects to thrive at that spot. IGSM & RI monitored grain quality at monthly intervals by taking samples from the top layers of grain using a sampling spear. There was a gradual quality decline over the storage period (Table 1).

5. Sustainable non-chemical stock protection for the future

It is planned that ten or more tonnes of crop will be placed in store after the kharif harvest in November/December and maintained in good condition until about June, the start of the monsoon season. One important danger faced by the grain stock is infestation by insect pests. Both *Sitophilus oryzae* and *Rhyzopertha dominica* are common on the crop although the latter is predominant (Hodges et al., 1999). Admixture of insecticide with the grain is not permitted in India and if silo storage is eventually to be extended widely, it would not be possible to provide sufficient trained support to enable reliance on phosphine fumigation. Thus alternative non-chemical means have been sort.

Farmers in Andhra Pradesh and other states are already very familiar with drying their crops by spreading them on the ground. Prior to storage, the commodity (freshly threshed) is sun dried for 15 days either close to the house or other convenient places such as roads. Dried grain is cleaned of inorganic and organic foreign matter and may be mixed with *Azardirachta indica* (Neem) leaves and then placed in the chosen storage structures which may be gunny bags, mudded bamboo baskets etc. Generally, insect

infestation is noticed after 4 to 5 months in grain harvested in the kharif season. Frequent sun drying and cleaning by picking and winnowing is used to control insect infestation.

In order to protect the stock to be put in the silos, without resorting to the use of chemical pesticides, it has been decide to try a process of solarisation since this is very similar to the existing practice of solar drying. The objective of solarisation is not to dry but to heat the grain and hold it at a high enough temperature to kill any insects that may be present. Solarisation has already been developed for use by smallholder farmers for the disinfestation of stocks of cowpea in Africa and pigeonpeas in India (Kitch et al. 1992; Chauhan and Ghaffar, 2002). However, the situation in India with sorghum presents some practical problems. The scale is quite different since about ten tonnes require treatment instead of 50 or 100 kg. In addition, some adaptive research is needed as sorghum grain is much smaller than either cowpea or pigeon pea and so the arrangements for solarisation will necessary need appropriate adjustment to ensure a complete insect kill.

The crop to be solarised is harvested at the end of the wet kharif season, during October. In the following months the number of rainy days is much reduced and the number sunshine hours much increased (Figure 1) facilitating solarisation. In order to prepare for solarisation of the kharif sorghum in October 2002, some preliminary tests were undertaken to determine the conditions necessary for a successful treatment. Two series of experiments were undertaken. In the first series, the solarisation was done on two layers of jute sacks to act as insulators. The sacks were covered by a layer of black polythene sheeting. Grain was placed on the black polythene that was then covered with a clear polythene sheet. The clear sheet was folded under the edges of the black sheet

and the edges weighed down with stones to give a fully sealed envelope. To establish the maximum depth of grain at which solarisation would still be fully effective, different depths of grain (1.0, 1.5, 2.0 and 3.0 cm), at a moisture content of 11.8% and already infested with *S. oryzae* and *R. dominica,* were solarised. The grain was in the sun from 10.00h to 16.00h and the maximum temperature observed under the sheeting was 54°C. Grain samples were taken at the end of treatment and incubated at 27°C for one month. No infestation was found in the samples collected from 1.0 and 1.5 cm depths, moderate infestation was found in the samples collected from 2.0 cm depth while heavy infestation was found in the samples collected from 3.0 cm depth. Similar results were obtained if the black sheeting layer, covering the jute sacks was omitted. The black sheet is clearly not essential but does help in the collection of the grain once the treatment is complete. However, insect kill was not achieved if the sack layer was omitted so emphasising the importance of the insulating layer.

A second series of tests was undertaken to observe whether the degree to which the envelope was sealed would affect the treatment performance and whether solarisation would have an effect on grain viability. The test was repeated as before, with grain depths of 1.5 cm and 2.0 cm, but the clear sheeting was either fixed under the edge of the black sheet to give a complete envelope or folded under the jute sacking to give a partial envelope. At the beginning and end of the test 100 undamaged grains were removed to test for germination. The results were as previously, with a complete insect kill at a depth of 1.5 cm, irrespective of whether there was a fully or partially sealed envelope. Of the untreated grains 88% germinated while none of those undergoing solarisation were viable. Clearly, it is important not to use solarisation to treat grain to be used as seed.

Solarisation of grain from the October 2002 harvest will be a test of the technique. In order to treat all the grain to be stored most members of the Group will have to be involved in this activity for several days. After treatment, grain will need to be loaded into the silos before insects have an opportunity to reinfest it. The silo itself has also been improved to reduce the likelihood of moisture migration through its walls, by painting external and internal surfaces with gas proof-paint. To prevent entry of insects the outlet port is now well sealed and the top hatch improved with additions to the cement collar making a tighter fit between this and the top cover. These precautions coupled with grain solarisation are expected to enable the Group to maintain their sorghum largely free of insect infestation for the period immediately after harvest in October until discharge in the following June.

6. Conclusions

The methods of group formation and grain storage are being documented to help develop a model by which decentralised grain storage can contribute to food security in rural India. The sustainability of this approach will become apparent over next few years. At least the strong emphasis on group formation and the development of appropriate systems by the Group itself should encourage a high degree of 'ownership' and give a greater chance of success than experienced with grain banks in the Sahel since the 1970s.

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References

Chauhan, Y.S., Ghaffar, M.A., 2002. Solar heating of seeds a low cost method to control bruchid (*Callosobruchus* spp.) attack during storage of pigeonpea. Journal of Stored Products Research 38, 87-91.

Günther, D., Mück, O., 1995. Les banques de cereales ont-elles banqueroute? Perspectives et limites d'un modele villageois de securite alimentaire au Sahel. Deutsche Gesellschaft für Technische Zusammenbeit (GTZ), Eschborn, Germany, pp 68.

Hodges, R.J., Hall, A.J., Jayaraj, K., Jaiswal, P., Potdar, N., Yogand, B., 2000. Quality changes in farm-stored sorghum grain grown in the wet or dry season in southern India - a technical and social study. In: Proceedings of the 19th ASEAN/1st APEC Seminar on Postharvest Technology, Ho Chi Minh City, Vietnam, 9-12 November 1999. Eds Johnson G.I., Le Van To, Nguyen Duy Duc and Webb M.C. ACIAR Proceedings No. 100, 333-345.

Kitch, L.W., Ntoukam, G., Shade, R.E., Wolfson, J.L., Murdock, L.L., 1992. A solar heater for disinfesting stored cowpeas on subsistence farms. Journal of Stored Products Research 28, 261-267.

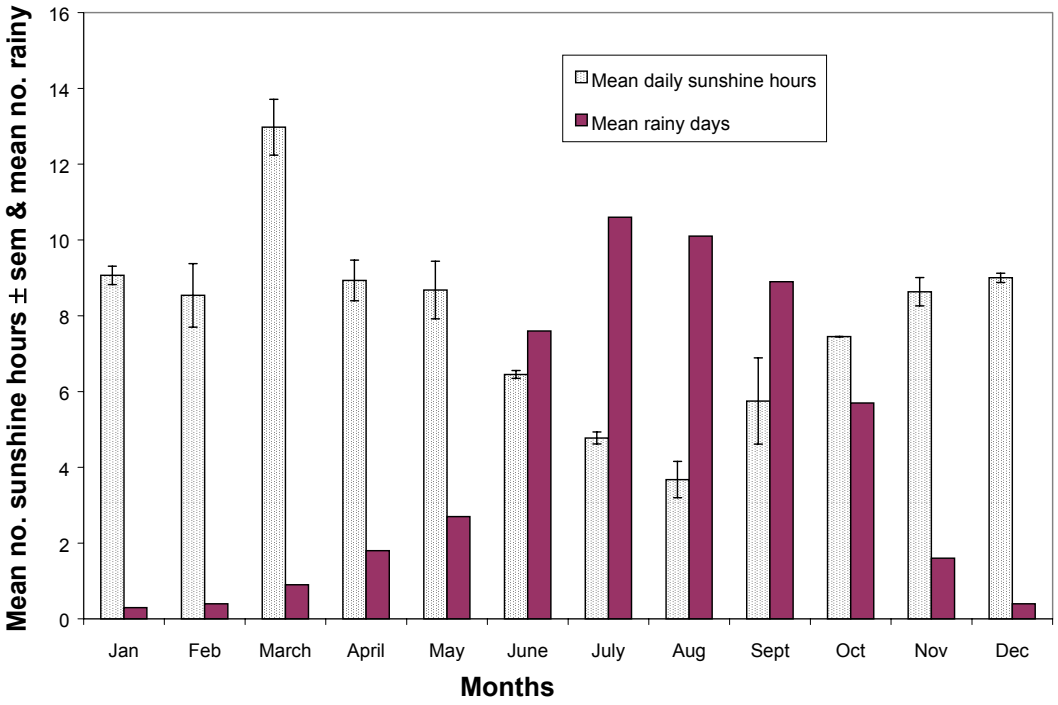
Table 1: Grain quality data for sorghum stored in a reinforced concrete silo at Mizapur in 2001

Month	% moisture content	% foreign matter	% shrivelled grain	% discoloured grain	% damaged grain	% weevilled grain
January	10.1	1.1	1.0	4.0	0.4	1.1
February	9.0	2.2	1.0	3.8	0.6	1.3
April	9.0	2.0	0.8	5.1	0.6	1.2
June	9.1	1.8	1.2	5.2	0.7	1.7
July	9.3	1.9	1.3	4.8	0.9	2.3
September	9.4	2.0	1.0	5.0	0.8	3.1
November	9.4	2.1	1.4	5.1	0.9	4.2
December	9.5	2.2	1.6	5.1	0.9	5.4

Figure caption

Figure 1: Mean number of sunshine hours (±sem) and rainy days at Hyderabad airport during 1999 and 2000

Figure 1


Mean no. sunshine hours ± sem & mean no. rainy
16
14
12
10
8
6
4
2
0
Mean daily sunshine hours
Mean rainy days
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
Months