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FINDINGS FROM FIELD STUDIES OF POST- HARVEST STORAGE AND PROCESSING IN AFGHANISTAN

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EXECUTIVE SUMMARY

Background

Post-harvest storage and food processing was neglected in Afghanistan's agricultural rehabilitation agenda after 2001. The few interventions that were prioritised – for example, installing refrigerated storage facilities for private sector companies – reflected donor emphasis on improving production and market development in areas of high potential, such as those that are well irrigated and close to urban centres. A few projects have worked at village level to improve customary practices using low-tech, zero-energy storage facilities. However, little attention appears to have been given to using solar power for food processing and drying at the household level.

Today, the infrastructural challenges for selling agricultural surplus are considerable. Physical access to markets can be difficult, given the country's poor road coverage and conditions. Often, households cannot afford vehicle costs and continue to use donkeys to transport goods. Although 84% of Afghanistan's population now has access to electricity, this is largely from the development of off-grid systems and solar energy for lighting rather than cooking. Less than 11% of rural Afghanistan is connected to the (unreliable) mains electricity (CSO, 2016).

Purpose and design

Systematic data are scarce on existing post-harvest processing and storage practices or the significance of post-harvest losses. Nor are data available on the role of women in this. A field study was carried out over six months from November 2022 to address this gap, comprising interviews with representatives from 47 households (both men and women) from 18 villages in Laghman, Herat and Badakhshan provinces. The study was designed to provide sufficient background information to justify post-harvest interventions and develop design criteria. It does not address the technical aspects of off-grid energy design and delivery.

Key findings

- Villages differ in terms of size, how land ownership is distributed and the proportion of households that have land. In some villages, up to 80% of households are reported by village informants to be landless. Self-evidently, interventions designed to address post-harvest management are targeted primarily to those who have land.
- The higher-altitude Badakhshan districts do not face the same post-harvest challenges of perishability of crop produce and susceptibility to pest and disease that are faced at lower altitude. Differences between districts and villages in terms of access to water, even major irrigation basins, should be noted.
- Customary post-harvest processing practices for grain staples are different from those of other crops. Grain staples are foundational to food security and are grown by all households. Only two households reported selling grain surplus deliberately at harvest time. Usually,

grain is stored, losses are low, and grain sales are discretionary and episodic based on need, to raise cash to meet other household expenditure.

- Potatoes and onions are cultivated by most households. High rates of loss of these fresh, perishable crops and other vegetables compel households to sell any crops that are surplus to immediate consumption needs at the time of harvest. Interviewees were aware that, in doing so, they sell at a time when prices are at their lowest and then later in the season buy in the same commodity at higher prices. Where households have access to improved storage facilities, they stressed the benefit of not selling for low prices at the time of harvest and keeping produce to meet household needs.



Selling potatoes, Herat, Afghanistan. Photo: Jim Kelly/Flickr

- In all three provinces, projects have been introduced to improve post-harvest storage. These have been targeted primarily to the storage of potatoes and onions, supporting the construction of simple zero-energy structures with enhanced insulation or aeration. These units have been installed for individual farmers on a cost-sharing basis on generous terms and for farmers with good connections with the authorities. It appears to have been assumed in programme design that beneficiary farmers will share the facilities with other farmers, but respondents reported that this was often not the case.

Policy and programme recommendations

- Greater attention is needed to post-harvest management issues in Afghanistan. In particular, attention should be focused on the importance of improved post-harvest storage from a subsistence and food security perspective, primarily for households living in remoter areas.
- Women play a significant role in post-harvest management, processing and storage of agricultural produce, and in particular in the processing of livestock products. Their role in this should be addressed more systematically in programme design.
- Careful attention should be paid to context in the design and implementation of post-harvest storage with respect to village social (land ownership) and agro-ecological characteristics, and to the selection of commodities that have the greatest potential for improved post-harvest management and/or income generation. The selected approaches to post-harvest storage must ensure inclusive access to any storage installed.
- The choice between a market-oriented or food security perspective is not a binary one. Most Afghan farming households are engaged in the market, even if their primary concern is meeting household subsistence needs. But expanding access to improved post-harvest storage facilities for smaller farmers and those with less market access by virtue of remoteness would give greater weight to a food security perspective.

1. INTRODUCTION

The rationale for this study draws on a review (Pain, 2022) of the available documentation since 2001 on infrastructural interventions to support post-harvest storage and processing in Afghanistan. Despite the obvious centrality of post-harvest practices to Afghanistan's agrarian economy, both to meet off-season consumption needs as well as the sale of agricultural surplus, the review confirms the lack of attention given to post-harvest management in Afghanistan's agricultural rehabilitation agenda after 2001. The review also notes that the few projects addressing post-harvest management have prioritised high-potential agricultural areas with access to on-grid energy sources and with a focus on commercial production for the market. They have not used a food security and nutrition lens to post-harvest management and have neglected to consider the significance of post-harvest management to households vulnerable to food insecurity.

The literature recognises the considerable infrastructural challenges to the marketing of agricultural surplus in Afghanistan, given the constrained physical access to markets due to limited and poor-quality road coverage. Moreover, less than 11% of rural Afghanistan is connected to the electricity grid (CSO, 2016), so any wider programme of improved storage and processing needs off-grid energy infrastructure derived from biomass, solar power, wind turbines or hydro power. Just one of the 18 villages in this study, located on the grid between Iran and Herat, accesses grid electricity.

There are also collective-action challenges if improved storage is to be delivered at a community level. As the findings reported here make clear, most of the support that has been given to zero-energy improved storage facilities has been targeted deliberately to individual, larger farmers. This targeting restricts access to others. Furthermore, if future interventions are targeted at the community level, much will depend on how the community operates as a collective. The assumption that households cooperate and show solidarity as a community because they reside in one location cannot be taken for granted (Katz, 2017).

But, as the review concludes, scant systematic data are available on existing post-harvest processing and storage practices, on the significance of post-harvest losses or on the role of women in this. The present field study was designed to address this gap. It aims to provide sufficient background and baseline information to be used to justify post-harvest interventions and to develop design criteria. It does not address the technical aspects of off-grid energy design and delivery.

2. SCOPE OF THE FIELD STUDY ON POST-HARVEST PRACTICES

The study was carried out in three provinces – Laghman, Herat and Badakhshan – and in contrasting districts within these provinces (see Table 1). These contrasts relate to access to irrigation, whether this allows single or double cropping, and to irrigated versus rainfed land. The districts can be contrasted also between low altitude (Laghman and Herat) and high altitude (Badakhshan), which imposes different post-harvest storage challenges and opportunities. Meanwhile, the river basins in both Laghman and Herat are the locations of two of Afghanistan's major port or border cities, Jalalabad and Herat, which have strong external trading links. As described in this report, physical access to markets varies significantly between districts and also between villages within districts, given the poor state of the roads. Accordingly, contrasting villages were selected in each district based on these criteria.

TABLE 1. SURVEYED PROVINCES, DISTRICTS AND VILLAGES AND THEIR IRRIGATION STATUS

Province	District	Village code	Irrigated (I) or rainfed (R)	Double (DB) or single (SG) cropped
Laghman	Mehtarlam (MH)	MH_V1	I	DB
		MH_V2	I	DB
	Alingar (AL)	AL_V1	I	DB
		AL_V2	I	DB
	Qarghayee (QG)	QG_V1	I	DB
		QG_V2	I	DB
Herat	Pashtoon Zarghoon (PZ)	PZ_V1	I	SG
		PZ_V2	I	SG
	Guzara (GZ)	GZ_V1	I	DB
		GZ_V2	I	DB
	Ghoriyan (GH)	GH_V1	I / R	SG
		GH_V2	I / R	SG
Badakhshan	Faiz Abad (FA)	FA_V1	R	SG
		FA_V2	I	SG
	Baharak (BH)	BH_V1	I	SG
		BH_V2	R	SG
	Jurm (JH)	JH_V1	I	SG
		JH_V2	I	SG

Source: The authors

The field study was designed around four broad thematic areas of inquiry concerned with building understanding of: existing post-harvest practices (Q1 and Q2), assessment of existing post-harvest storage facilities (Q3), and assessment of the potential for support to improving post-harvest storage facilities (Q4). These thematic areas informed data collection and are discussed in turn in the findings that follow.

Representatives from five or six households were interviewed within each district. Male participants were interviewed in person by male members of the research team, while female participants were interviewed by telephone by female members of the research team, reflecting the restrictions placed by the Taliban government on women's mobility. A total of 47 men and 41 women were interviewed. In addition, other informants at the provincial or district level were included in the assessment to enhance the data collected. These informants include government officials from the Department of Agriculture (DAIL), individuals from the local Afghanistan Chamber of Commerce (ACCI), community elders, traders and workers from non-governmental organisations (NGOs). Table 2 summarises the informants by district and province. See the provincial annexes (Annex 2: Laghman, Annex 3: Herat and Annex 4: Badakhshan) for more detailed information on the household informants.

TABLE 2. INFORMANT TYPE AND NUMBERS BY DISTRICT

Province	District	Farming households	Other informants		
			Elder/trader	ACCI	Government and NGOs, etc.
Laghman	Mehtarlam	5	4	1	2
	Alingar	6			
	Qarghayee	5			1
Herat	Pashtoon Zarghoon	5			
	Guzara	5	2	1	3
	Ghoriyan	6			
Badakhshan	Faiz Abad	5	2	1	3
	Baharak	5	1		
	Jurm	5	1		

Source: The authors

Household interviews generated information on land-owning structures in the village, household composition, individual household land holdings and income sources, and on post-harvest storage practices and losses by crop. A particular point of inquiry was the role of men and women in these activities. Questions were also asked about prior interventions in relation to post-harvest storage and household access to these facilities.



3. FINDINGS

Findings from each province and the details of the informants are included in Annexes 2 (Laghman), 3 (Herat) and 4 (Badakhshan). The discussion here provides a comparative analysis across the provinces and districts, drawing on the content of these annexes.

Differences in land-owning structures and the significance of agro-ecological variability

The selected villages differ in terms of their size or number of households, how land ownership is distributed and the proportion of households that have land (or conversely are landless). Self-evidently, interventions designed to address post-harvest management are targeted primarily to those who have land. The proportion of households without land in many of the surveyed villages (see, for example, in Laghman MH_V2 or QG_V1 where 80% of the households were reported by village informants to be landless) makes clear how many households within a village are very unlikely to benefit directly from post-harvest interventions. Comprehensive cadastral land records do not exist in Afghanistan and such information has to be collected from informants at the village level. However the findings here are consistent with data from other studies (Pain and Huot, 2018). Equally, in each of the provinces, between one-quarter (in Herat) to nearly half of surveyed households (in Badakhshan and Laghman) who by definition have land could not meet a full year's subsistence requirement of grain (wheat or rice), for

example, from on-farm production. An additional variable to land-holding size that needs to be borne in mind is that of household size, since the median household size across all three provinces stood at around 10 at the time of the interviews, with the maximum rising above 25 people. While benefiting from labour resources, large joint households demand more in terms of basic food requirements.

The differences between provinces are worth stressing, as these justified the basis for their selection. The higher-altitude Badakhshan districts do not face the same post-harvest challenges of perishability of crop produce and susceptibility to pest and disease that the same crops face at lower altitude. Similarly, differences should be stressed between districts in terms of access to water, even in major irrigation basins such as the Hari Rud around Herat. Interviewees in Guzara district, the closest to Herat City, reported reliable double cropping while in the other two districts – one upstream and the other (Ghoriyan) downstream of Guzara – interviewees reported only single cropping. The villages in Ghoriyan were suffering from an absolute lack of water at the time of the field research.

There are differences too between villages *within* a district in terms of physical access and the availability of water. The contrast between the two Pashtoon Zarghoon villages demonstrate this – one village (PZ_V1) has a grape economy based on reliable irrigation and a good road connecting it to Herat City, while PZ_V2 is some two hours by dirt road from the district centre and faces water constraints. The proximity to a road is a key factor in melon being an important crop for a village in Baharak in Badakhshan, since the fruit can be sold to passing customers.

Beyond these physical contrasts are cultural differences. Districts or villages that are primarily Pashtun – Pashtoon Zarghoon, for example, in contrast with those of Badakhshan – are more likely to be Tajik. This affects the role that women can play in the community and the economy, and their visibility in the public world.

Existing practices

Q1: What are existing household and village post-harvest storage and food processing practices, for what agricultural products (vegetables, fruit, nuts, livestock products), at what scale, who (and from what sorts of households) undertakes them, and how effective (losses) are they seen to be?

Table 3 summarises the household portfolios by crop, province and district. There are commonalities in crop type across all locations, including for wheat, potatoes, onions, tomatoes and a range of other vegetables and, worth stressing, livestock products. But there are also important differences – rice is confined to those locations with double cropping, saffron to Herat, walnut and apricot to Badakhshan, and melons to Badakhshan and one district in Herat.

Post-harvest storage and food processing practices for the grain staples can be separated from those applied to other crops. In part, this divide reflects the fact that grain staples are foundational to food security and are grown by all surveyed households. Only in a couple of cases did households report that they deliberately sold grain surplus at harvest time; in all other cases it was stored, and grain sales were discretionary and episodic, based on need, to raise cash to meet other household expenditure. The grain staples, if harvested under hot and

dry conditions and at maturity with low moisture content are in a natural condition for storage, with sources of loss being pest or insect damage. In Laghman, customary practices of cleaning and storage in which female members of the household are heavily involved include the storing of grains in sacks in the house and the use of a chemical treatment to control insect pests. Similar storage practices were reported by households in Herat and Badakhshan, although in the latter province there were no reports of chemical treatment. Interviewees in Badakhshan reported that there had been a shift to storing wheat in metal containers, a practice introduced by migrating workers who had seen this practice in Iran. In all cases, storage losses were reported to be low or of not sufficient concern given the length of time that grain reserves had to last.

TABLE 3. FARMER CROP PORTFOLIOS BY CROP, PROVINCE AND DISTRICT

	Number of households reporting cultivation								
	Laghman			Herat			Badakhshan		
	MH	AL	QG	PZ	GZ	GH	FA	BH	JM
Wheat	5	5	5	5	5	5	5	5	5
Rice	5	6	5	1	3	0	0	0	0
Maize	0	4	2	1	0	0	3	1	1
Beans	1	1	0	2	3	1	2	5	5
Potatoes	5	5	3	3	5	1	3	5	4
Onions	5	6	5	4	4	5	3	5	4
Tomatoes	2	2	5	3	5	2	3	4	3
Okra	4	0	1	1	1	2	0	1	0
Eggplant	1	0	1	2	2	2	2	1	1
Squash	0	0	1	0	0	1	0	1	0
Lettuce	0	4	1	0	0	0	2	0	0
Grapes	0	0	0	?	?	?	0	0	0
Saffron	0	0	0	?	?	?	0	0	0
Walnuts	0	0	0	0	0	0	?	?	?
Apricots	0	0	0	?	?	?	?	?	?
Livestock products	5	6	5	3	4	3	4	5	5

Source: The authors

Processing through simple sun-drying is a widespread practice for a considerable number of crops destined for household consumption. This work is done by women and at household level is limited in the scale or the volume of produce that can be handled in this way. Sun-drying is applied to tomatoes, okra, eggplants, onions, apricots and livestock products such as *qurut* (dried yogurt). Study participants reported that crops dried in this way have long-term storage possibilities, although the extent to which this is put to the test depends on the rate of consumption and volume of produce preserved in this way.

As noted above, potatoes and onions are commonly cultivated by most households across the three provinces. Customary post-harvest management in which women play a key role includes cleaning potatoes and storing them in sacks and for onions laying them out to dry and storing in a room. Storage management relies on regular checks of produce and the disposal of any of the harvest that is rotting. In Badakhshan, interviewees reported building clamps in the ground to store potatoes. In the warm, humid climate of Herat and Laghman, interviewees reported that these customary methods of storage are of limited effect and storage losses after a couple of months can be high – up to 50% or more. In Badakhshan’s cold winters, customary storage was reported to be much more effective (although there are dangers of losses due to frost) and potatoes and onions can be stored through to spring.

The high rate of loss in the fresh, perishable crops – and this includes some other vegetables such as tomato, cabbages and so forth – essentially compels households to sell any surplus over and above immediate consumption needs at the time of harvest. Interviewees were very aware that, in doing so, they sell at a time when prices are at their lowest. Many of the female interviewees commented that later in the season they end up buying in the same commodity at higher prices – sometimes double or more – to meet household consumption needs. Indeed, households with access to improved storage facilities for potatoes or onions stressed the primary benefit of not having to sell for low prices at the time of harvest and being able to keep more of their produce to meet household needs.

A key point to be made here is that, although many farming households across the provinces and particularly in Herat and Laghman are engaged in the market, it is evident from their comments that they are oriented towards meeting subsistence needs and not maximising income from market sales. A comment that was made across all three provincial locations is

Agriculture in Afghanistan. Photo: UN Photo/Fardin Waezi



that, since the Taliban had come to power, loss of employment for those who had worked in government or the armed forces and the economic downturn has made meeting consumption needs through production an absolute priority, and those with land farm to meet that objective.

However, for two crops, both grown in Herat, which in several respects has a more commercial economy than in the other two locations, production has been oriented much more towards the market. The first, fresh grapes (and raisins from grapes) has long been an important commercial crop, although confined to reliably irrigated areas and to those farms with more land. Traditional methods of processing are still practised both for the black and red raisin grape varieties and for the green raisin varieties; although, as we see below, new raisin processing facilities have been promoted.

The second crop that has been grown entirely for the market is saffron. This is a relatively recent crop that was introduced as an alternative to opium poppy and has established itself as a high-value crop. However, saffron is a semi-perennial with high capital investment costs and returns that are only significant from the second year onwards. It is grown largely by farmers who can easily meet their subsistence requirements, and who have sufficient land area or other sources of income to handle the risk of investment. Saffron has been promoted because it is seen to have potential to generate employment, particularly for women on the harvesting and processing side. Indeed, around 5,000 women and children are hired every saffron harvesting season to clean and process saffron flowers. This work is generally paid on a piece rate and generates significantly lower income for women than comparable work by men. It usually takes place in spaces designated for women. The short-term nature of employment and the low rates do not offer a living wage or significantly change the employment constraints women face. A contributory factor to the employment of women may be that the short harvest season with high labour demand cannot be met by the available male labour supply, as many men migrate to Iran for work. Saffron processing is labour intensive, involving flower picking, separating the stamens from the flowers, cleaning, sorting and then drying them. This is done quickly to maximise the value of the crop.

Many households across all three provinces have livestock and here women play a key role in the collection and processing of milk products. In Badakhshan, women may accompany the livestock herds to the summer pastures to fulfil these tasks. While many households may process these products into yoghurt or cheese, the limited ability to store these products or fresh milk means that any surpluses are sold on a very small and local scale. Often children take the products to local markets or other households. Reflecting the commercialisation of the economy there, factories have been established in Herat City to process milk products to meet urban demand and there is a growing market for milk products from neighbouring districts to meet that demand. An interviewee from one of the Laghman villages (QG_V1) also reported a more commercial market for fresh milk that is exported to Kabul.

Q2: If crop surpluses/processed products are sold, who sells them, where (and how far) and to whom are they currently sold and in what quantities? What income is generated from this? What changes have taken place over the last 10 years?

As the above section makes clear, farmers sell a wide range of products, but this only occurs in a few cases because stock is surplus to household consumption needs or grown deliberately for the market, such as with saffron. This arises when a household has large landholdings or when the household has other significant sources of non-farm income. Products include wheat, grapes, onions, potatoes and tree products. Only four of all of the households

interviewed reported that they were in this position with respect to the sale of annual crops, although more reported that they might sell surplus from fruit trees. While in all cases farm sales are handled by men (or in the case of fresh milk and cheese children might sell them on behalf of their mother), the issue of who a product is sold to and where depends on the product, location of the farm, proximity to urban markets and, above all, road infrastructure. In Laghman and Herat, for example, traders might come directly to the farm to buy the standing crop (as in the case of onions or grapes), which entails larger volumes.

In Badakhshan, with lower temperatures and colder winters, the pressures to sell crops immediately at harvest time to reduce losses are less acute. However, for most of the interviewed households in Laghman and Herat, the perishability of vegetable crops and their limited ability to store them without significant post-harvest losses encourages them to sell their crop as quickly as they can if the quantity is surplus to their consumption needs in the immediate months after harvest. But as many households noted, the consequences of selling at harvest time are that they sell when prices are at their lowest and often end up buying in the same produce – onions and potatoes – later in the season to meet consumption needs when prices are much higher. The dividend from improved storage for such households in terms of increasing self-provisioning and reducing food costs surely justifies targeting post-harvest storage to such households.

One village in Badakhshan – which by virtue of location (adjacent to a much-used road) and its cultivation of one seasonal crop (melon) – has significant cultural meaning (equivalent to the strawberry season in the United Kingdom) and benefits from being able to sell readily to passing trade.

Households that might only marginally meet their grain staples requirement for the year reported that they also use their grain reserves as a currency at times of cash need to exchange (through barter in some cases) for other household necessities or sell directly for cash to be able to purchase necessities. Households in Badakhshan that grow beans reported that they also use the beans as a reserve commodity to be sold in times of need.

Sales quantities are difficult to assess (due to the reliability of reporting) and to generalise (see Annex 1, Table A 1 for household-reported details). They depend on household, location, season and commodity. For potatoes in Laghman, sales quantities were reported to vary from 200 kg to 15 tonnes and for onions from 200 kg up to 8,000 kg. A similar range was reported in Herat, while sales in Badakhshan were reported at lower levels. Sales income is difficult to assess given the variable quantities sold, the extent to which sales reflect interlocking contracts and meeting credit advanced from a trader, and the fact that some sales are more simple exchanges – either in cash or bartering to meet household needs.

Post-harvest storage facilities

Q3: Who constructed, who owns, and who is responsible for the maintenance of these storage facilities? Who is eligible to use these facilities, and under what conditions? What energy sources (e.g., sun, solar power, bio-gas, etc.) are used for any processing and have these changed?

In all three provinces there have been projects to introduce improved post-harvest storage. The National Horticultural and Livestock Programme (NHLP) has been the most significant source of these projects. These have been targeted primarily to the storage of potatoes and onions,

with the programme having supported the construction of simple zero-energy structures with improved insulation or aeration. None have had an external energy source such as solar power or bio-gas. There were reported to be about 190 of these structures in Laghman and about 400 to 500 in Herat, but in Badakhshan the programme started late and had only constructed a few by the time of the Taliban take over in August 2021. In Herat, the NHLP appears to have established a larger programme for the processing of grapes and reportedly some 1,300 to 1,400 of these zero-energy structures have been constructed. There have been other interventions too, such as the recent introduction of improved storage bins for wheat in Herat.

With one exception in Badakhshan, these improved storage units have been installed for individual farmers on a cost-sharing basis on generous terms, and the beneficiary can contribute in-kind by providing land or labour or by covering some 10%–15% of the total cost. The farmers are expected to maintain the facility. Moreover, there are usually specific criteria such as the farmer must have a minimum amount of land dedicated to the crop – for example three *jeribs* (a traditional unit of land, equivalent to one-fifth of a hectare) of onions, as reported in Laghman – to be a beneficiary. As was made very clear by interviewees in Herat and Laghman, those who have benefited usually have good connections with the authorities. A consequence of this selection bias has been that many smaller farmers growing the same crop (although often for subsistence purposes primarily) have not been included in the programme.

Although this is not clear, it may have been assumed in programme design that the beneficiary farmer will share the post-harvest storage facilities with other farmers. However, interviewees reported that this is often not the case. In the three study villages in Laghman where cold storage facilities have been installed, respondents described very mixed access to the facilities. In one village, it was reported that a large landowner with sharecroppers allows them and his relatives but not others to use the store. In a second village, the two beneficiaries allow other unrelated households to use the facility, although some are located too far away to be able to do so. In a third village, interviewees reported that the landowner with the facility refuses to allow others to use it and this has been a point of conflict in the village. This variability in access was also noted by respondents with respect to onion storage in Herat. In the case of raisin processing, grapes are largely cultivated by households with more land so the issue of access by others to the facilities is not so significant.

Among those who had enjoyed access to an improved cold storage facility for potatoes or onions or a facility for processing grapes, the benefits were seen to be considerable given the significant reduction in post-harvest losses for these crops. Those who have considerable surplus over and above household consumption needs can store produce until they judge that they can get the best market prices. Among those oriented more towards subsistence, and in a sense reluctant sellers of surplus, three benefits were perceived: first, in terms of reducing post-harvest losses (and extending the possible storage period after harvest); second, in being able to increase the proportion of the harvest that could be used for household consumption purposes and thereby reducing household expenditure on buying the commodity once household reserves are exhausted; and third, in being able to wait to sell surplus until prices increase after the immediate harvest period. While the informants did not rank these benefits, it was clear in the interviews that the savings benefits are particularly valued. This reflects the common observation from the many households without non-farm income that their primary concern is meeting consumption needs, and only once those are met, or when they are compelled to sell to meet other household expenses, are crop reserves sold.

Implications and potential

Q4: What are the constraints to existing storage/processing practices in terms of effectiveness, scale etc.? Are there any agricultural products that are only consumed fresh but have potential in terms of supply (surplus) being available for storage and processing? What would be the objectives of the expansion – primarily food security or market-oriented?

It is evident from the data collected that even the relatively limited coverage of zero-energy improved cold storage facilities has contributed to a significant reduction in post-harvest losses for key perishable crops – but only for those farmers who have access to the facilities. The programme has been limited not only in the extent of its coverage, which is in part determined by its focus on individual farmers, but also in its bias towards processing surplus for the market. This has resulted in a spatial bias that limits the programme to more accessible, better irrigated areas. In this sense, so far, the interventions appear not to have considered the importance of improved post-harvest storage from a subsistence and food security perspective, particularly for households living in remoter areas. Arguably, given the downturn in Afghanistan's economy and the loss of employment, this perspective is even more important now. Furthermore, by design, the programme does not appear to have specifically addressed the significant role of women in post-harvest management, processing and storage of agricultural produce, or the role of women in the processing of livestock products.

If access to improved post-harvest facilities is to be expanded – justified by taking on board a food security and nutritional perspective to post-harvest management – then by implication, this will require a shift from a focus on individual provision to one that supports the provision of a collective or village public good. However, if programmes are to be targeted at the community level, then much will depend on how the community operates as a collective, and there are clearly challenges here which need to be addressed in design and implementation. There is scope, of course, for targeting interventions to smaller groups of households or women who may be connected through networks of relations or by neighbourhood links.

Expanding access is one matter, and it is a technical design question whether facilities that draw on off-grid energy can significantly and economically improve post-harvest storage over and above the improvement provided by the zero-energy facilities that have been installed so far. Equally, the choice between a market-oriented or food security perspective is not a binary one, and these are not exclusive categories. Most Afghan farming households are engaged in the market, even if their primary concern is meeting their household's subsistence needs. But expanding access to improved post-harvest storage facilities for smaller farmers and those with less market access by virtue of remoteness (e.g., in Badakhshan) would give greater weight to a food security perspective.

A broader perspective might expand the technical approaches to post-harvest processing as well as the crop portfolio. For example, there may be scope for solar powered drying of perishable vegetables such as tomatoes and eggplants or fruits (e.g., apricots) to expand the scale of domestic processing that will increase household food reserves. And this could also serve local markets. Likewise, the use of solar powered refrigeration might offer technical opportunities for greater storage of livestock products, again with the potential to serve local markets. It is not immediately obvious that there are specific crops which are only consumed fresh currently but that hold potential for processing and storage. However, this is not to exclude the possibility and the case remains to be made.

ANNEX 1. ANNUAL CROP HARVEST AND SALES DATA

TABLE A 1. ANNUAL CROP HARVEST AND SALES (KG) BY PROVINCE, DISTRICT, HOUSEHOLD AND COMMODITY

LAGHMAN		Crop harvest (kg) (Sales (kg) in brackets)				
Mehtarlam	HH01	HH02	HH03	HH04	HH05	
Wheat	8,960 (6,500)	2,688 (-)	2,870 (-)	280 (-)	5,600 (4,480)	
Rice	6,720 (5,600)	1,960 (1,120)	2,800 (2,730)	6,720 (5,740)	1,400 (700)	
Potatoes	1,400 (700)	2,800 (2,730)	1,750 (1,750)	19,600 (18,680)	3,360 (3,360)	
Onions	2,800 (2,450)	8,400 (8,300)	2,100 (2,100)	2,100 (1,750)	280 (-)	
Alingar	HH01	HH02	HH03	HH04	HH05	HH06
Wheat	21,840 (19,600)	4,480 (-)	6,160 (-)	-	2,800 (-)	480 (-)
Rice	3,080 (700)	840 (-)	1,120 (700)	-	1,680 (770)	840 (400)
Potatoes	1,670 (1,470)	210 (-)	840 (350)	-	280 (-)	-
Onions	1,400 (1,120)	210 (-)	700 (-)	45,500 (45,500)	350 (-)	210 (-)
Qarghayee	HH01	HH02	HH03	HH04	HH05	
Wheat	7,000 (5,600)	1,200 (-)	-	-	2,100 (-)	
Rice	-	-	-	1,400 (630)	-	
Potatoes	-	-	210 (-)	280 (-)	-	
Onions	8,400 (1,540)	-	210 (-)	280 (-)	-	
Tomatoes	12,600 (12,600)	6,720 (6,720)	-	-	4,620 (4,620)	
Cabbage	8,400 (8,400)	5,600 (5,600)	-	-	-	
Cauliflower		7,000 (7,000)				

HERAT		Crop harvest (kg) (Sales (kg) in brackets)				
Pashtoon Zarghoon	HH01	HH02	HH03	HH04	HH05	
Wheat	12,000 (6,160)	3,200 (1,600)	1,600 (-)	2,400 (-)	5,600 (2,800)	
Potatoes	-	105 (-)	-	-	-	
Onions	800 (400)	800 (400)	-	-	40,000 (39,920)	
Tomatoes	3,600 (3,600)	-	-	-	-	
Grapes and raisins	-	-	6,000 (6,000)	12,800 (1,200)	19,200 (19,200)	
Guzara	HH01	HH02	HH03	HH04	HH05	
Wheat	3,400 (480)	1,600 (-)	2,100 (700)	2,000 (1,200)	6,800 (5,200)	
Rice	320 (-)	-	-	-	-	
Potatoes	2,700 (2,600)	-	-	4,000 (4,000)	9,200 (9,200)	
Onions	6,000 (5,800)	3,000 (2,200)	320 (160)	200 (160)	6,800 (6,000)	
Tomatoes	-	-	-	400 (400)	8,000 (8,000)	
Cotton	600 (600)	-	-	-	-	
Mung beans	400 (400)	-	-	-	350 (-)	
Grapes and raisins	-	-	32 (16)		8,800 (8,400)	
Ghoriyan	HH01	HH02	HH03	HH04	HH05	HH06
Wheat	38,500 (31,500)	-	6,000 (4,000)	2,415 (-)	520 (-)	3,400 (2,200)
Onions	-	-	16,000 (15,600)	-	180 (-)	58,800 (58,680)
Saffron	5-7 (5-7)	0.6 (0.6)	7 (7)	1.7 (1.7)	4 (4)	4 (4)
Grapes and raisins	2,800 (2,765)	-	16,000 (12,000)	-	-	-

BADAKHSHAN					
Crop harvest (kg)					
(Sales (kg) in brackets)					
Baharak	HH01	HH02	HH03	HH04	HH05
Wheat	3,500 (-)	3,150 (-)	1,400 (-)	1,680 (-)	840 (-)
Potatoes	16,800 (14,000)	700 (490)	420 (-)	280 (-)	350 (-)
Onions	10,500 (10,080)	5,600 (5,390)	420 (-)	2,100 (1,820)	525 (315)
Tomatoes	-	1,050 (100)	-	-	-
Melons	-	-	7,000 (4,000)	5,250 (5,250)	1,680 (1,680)
Apples	-	-	1,750 (1,860)	-	1,890 (1,890)
Beans	350 (280)	-	350 (280)	35 (-)	-
Jurm	HH01	HH02	HH03	HH04	HH05
Wheat	5,250 (1,400)	840 (-)	1,120 (-)	2,500 (700)	1,225 (-)
Potatoes	700 (280)	700 (490)	10,500 (10,220)	245 (-)	-
Onions	700 (350)	-	2,100 (1,890)	210 (-)	-
Tomatoes	420 (400)	-	-	-	-
Beans	420 (280)	147 (147)	2,100 (1,890)	900 (760)	784 (770)
Apples	-	-	1,400 (1,400)	-	-
Faiz Abad	HH01	HH02	HH03	HH04	HH05
Wheat	3,360 (-)	1,050 (-)	2,800 (-)	3,500 (-)	3,500 (-)
Potatoes	-	-	1,400 (-)	350 (-)	2,100 (1,750)
Onions	-	-	1,500 (-)	1,400 (1,120)	2,100 (1,750)
Tomatoes	-	-	4,000 (3,990)	2,100 (1,610)	1,500 (350)
Flaxseed	70 (-)	-	-	-	-
Dairy products	-	-	5* (5)	4* (4)	4* (4)

Note: * Daily sales

Source: The authors

ANNEX 2. LAGHMAN

Context

Laghman province, located in eastern Afghanistan, has a sub-tropical climate. With water from the Kabul, Alingar and Alishing rivers, it has a large, well-irrigated area in the plains, which allows two crops a year. This is a productive landscape providing a significant agricultural component to the livelihoods of those who have access to land and who farm it. But many don't. Rice and vegetable crops are cultivated in the summer season, while wheat and other more temperate crops such as onions and potatoes are widely grown in the winter season. A range of fruit trees are also grown.

The Afghanistan Research and Evaluation Unit (AREU) study was carried out in three districts – Mehtarlam (which contains the provincial capital), Alingar and Qarghayee. Two villages were sampled in each district (see Annex 1). Representatives from a total of 16 farm households were interviewed in the province. The men from the households were interviewed in person in the field, while the women were interviewed by phone by female members of the AREU research team. In addition, six informants were interviewed, including traders, NGO workers and village elders.

Land ownership distribution and social structures differ between villages and this affects the access households have to available village-based crop storage facilities. Of note are the levels of landlessness reported by informants, which range from 20% to 80% of households in the six study villages. Both Mehtarlam villages have around 40–50 households. In the first village (MH_V1, 40% landless), several households were reported by informants to have more than five *jeribs* of land, while in MH_V2 (80% landless) there is just one major landowner with more than 80 *jeribs*. The villages in Alingar are very different in size. Village AL_V1 has about 20 households, all closely related (plus one *hamsaya* or 'servant' household), with relatively equal landholdings of about 8–15 *jeribs*. Village AL_V2, on the other hand, is a large village of 400 households (50% landless), with about 15 households having 10–15 *jeribs* and the rest having substantially fewer. In Qarghayee district, the first village (QG_V1) has about 300 households (80% landless), with one large landholding household (40 *jeribs*), around eight households with 15 *jeribs* of land and the rest with a few or no *jeribs*. Prior to the regime change in August 2021, many people were employed in the police and army – since then they have lost their jobs, with consequences for household income. The second Qarghayee village (QG_V2) has about 40 households (20% landless), with one large landowner (60 *jeribs* of land) who recently died. His lands have been distributed among his relatives and the remainder of the village households are *hamsaya* or tied households in dependent relations with their landlords.

Table A 2 provides summary information on the Laghman study informants, including their household size, farm size, access to land through ownership or sharecropping, sources of income and the number of months they can self-provision the household from own-farm production. Key points to note across the 16 households include: the variation in household size (maximum 35, minimum 2, median 12), with the larger (13 of the 17) households (of more than 10 individuals) being joint households; the range of farm sizes; the significance of sharecropping to access land (8 of the 17 households); and the months of self-provisioning for

the households from the land that is farmed. Two of the farm households reported that non-farm income is their first source of income – for all others it is agriculture supplemented with other sources of on- and off-farm work.

Existing practices

Q1: What are existing household and village post-harvest storage and food processing practices, for what agricultural products (vegetables, fruit, nuts, livestock products), at what scale, who (and from what sorts of households) undertakes them, and how effective (losses) are they seen to be?

Post-harvest storage and food processing practices for the grain staples (wheat and rice) can be separated from those applied to other crops. In part, this divide reflects the fact that grain staples are foundational to food security, and both are grown by all but two households (AL_HH04, QG_HH03) interviewed. They are grown for household consumption and only in one case (AL_HH01), where non-farm income sources are the primary household income source, is surplus sold intentionally at harvest. For all other households, both for those who are grain self-sufficient or in deficit, grain sales are discretionary and episodic based on need, to meet other household expenditure. If harvested under hot, dry conditions and at maturity with low moisture content, the grain staples are in a natural condition for storage. The major sources of storage loss are pest or insect damage. Customary practices of cleaning and storage – in which women members of the household are heavily involved for all crops – include storing the grains in sacks in the house and using chemical treatment or a 'pill' (as described by interviewees) to control insect pests. Storage losses were reported to be low.

In Alingar and Mehtarlam, most households interviewed also grow potatoes and onions and other small areas of vegetable crops. In Qarghayee, there is a wider portfolio of vegetable crops, including tomato, cabbages and cauliflower, but not every household grows all of them. However, in the case of fresh and more perishable crops such as potatoes, onions and various vegetables (garlic, tomatoes, cauliflower, etc.), customary storage practices and the losses associated with them essentially compel households to sell anything over and above their own short-term consumption needs at harvest time. Interviewees were aware that they sell at a time when prices are at their lowest and often commented that they end up buying in the same commodities later in the season at higher prices (double or more) to meet consumption needs. No households reported growing a crop that is solely for sale to the market as all production contributes to household consumption needs.

The discussion for this technical report focuses on potato and onion storage and sales by households in the villages that do not have an improved cold storage facility (AL_V2, MH_V2 and QG_V2), or where there is one but the owner does not allow access to it (QG_V1) by other households. We return to this discussion point below. In two villages with improved cold storage facilities (AL_V2 and MH_V1), all households can use the facilities if they wish. Customary practices for storing potatoes, when they are kept, consist of cleaning and drying the potatoes (by women) and putting them in sacks which are then stored in a room of the house. When potatoes are stored like this, they can be kept for a few months with losses of up to 40%. Women check the potatoes regularly and throw out the damaged tubers. Onions, regarded as more perishable, are often also stored in a room in the house and regularly inspected for damage, with the spoiled ones being thrown away. Onions stored in this way have a relatively short shelf life, and after a month or so losses of more than 30% can rapidly be

incurred. Some women also reported that they sun-dry onions and sliced potato as a means of preservation for household use.

Women have a particular role in the processing of livestock products such as yoghurt and milk. Where there are small household surpluses, these can be sold by women at the village level but not beyond. In one village (QG_V1), there is a more commercial market for fresh milk which is exported to Kabul. Interviewees gave no details on the role of women in this.

Q2: If crop surpluses/processed products are sold, who sells them, where (and how far) and to whom are they currently sold and in what quantities? What income is generated from this? What changes over the last 10 years?

As indicated above, the perishability of vegetable crops encourages households to sell produce as quickly as they can, if they are surplus to consumption requirements in the immediate months after harvest. A range of sale practices are followed, and men are responsible for all crop sales. Crops can be sold within the village if there is demand or more often they will be sold to a trader who comes to the village. The trader will buy the crop from the field in some cases, or they will buy it directly after it has been harvested. Some households with better connections and larger product quantities may sell to a regional trader or even to traders in Kabul. Sales quantities are variable between households and between seasons. They can range from 300 kg to 15 tonnes or more in the case of potatoes and from 200 kg up to 8,000 kg for onions. Sales income is difficult to assess as quantities sold are highly variable and the income is often used to purchase goods to meet household needs.

There were a couple of comments in the interviews concerning the role of women in Laghman, who have the responsibility for livestock management and milk processing (yoghurt and cheese). Respondents indicated that women can sell surplus locally within a village to relatives, but it was clear that women's ability to sell in commodity markets beyond villages is very limited.

Post-harvest storage facilities

Q3: Who constructed, who owns, and who is responsible for the maintenance of these storage facilities? Who is eligible to use these facilities, and under what conditions?

Various efforts have been made by aid agencies to improve post-harvest storage facilities in Laghman. One large facility powered by electricity was funded the American Provincial Reconstruction Team (PRT), but the absence of reliable electricity in the province means that it has never worked. However, the NHLP supported the construction of a simple, natural storage facility with improved insulation at the village level and one source said that about 190 of these are in Laghman. The costs of construction were reported by one informant (MH_NGO) to be between 350,000 Afs and 450,000 Afs (£3,250 and £4,000). These storage facilities were targeted and installed for individual farmers who were judged to have sufficient land and the level of production of onions and potatoes to use them. It appears that NHLP assumed these facilities would be shared with other households in the village. However, this is not always the case, and several respondents observed that those who were beneficiaries of the cold storage facilities were those who had good connections with the authorities. Maintenance of the facility is expected to be carried out by the owner.

As noted above, three of the study villages (AL_V1, MH_V1 and QG_V1) have improved cold storage facilities installed. With respect to AL_V1, the cold storage facility was installed on the land of the largest landowner (AL_HH01) and he and his relatives in the village use the facility. It is also clear that sharecroppers on his land (AL_HH03) can use the facility, but village households with no relations to the landowner (AL_HH02) do not use it. In the case of MH_V1, two cold storage facilities have been built, but here it was reported that the owners allow other unrelated households to use the facility. Some have not used it, despite being permitted, with distance to the cold storage being an important consideration that may restrict its use. In the case of QG_V1, one cold storage facility has been built for a private farmer and he does not allow others to use it. It was clear in the interviews that respondents feel considerable resentment about this restriction, and it is a point of conflict within the village.

Among those who do have access to cold storage, the benefits were seen to be considerable. These are threefold: first, in terms of reducing post-harvest losses (and extending the possible storage period after harvest); second, in being able to increase the proportion of the harvest that can be used for household consumption purposes and thereby reducing household expenditure on buying the commodity once household reserves are exhausted; and third, in being able to wait to sell surplus until prices increase after the immediate harvest period. While the informants did not rank these benefits, it was clear in the interviews that the savings benefits are particularly valued. This reflects the common observation from the many households without non-farm income that their primary concern is with meeting consumption needs and only once those are met, or when they are compelled to sell to meet other household expenses, are crop reserves sold.

Q4: What energy sources (e.g., sun, solar power, bio-gas, etc.) are used for any processing and have these changed?

The reference to the unused PRT refrigeration cold storage unit makes clear the lack of reliable mains electricity. No one mentioned the use of bio-gas. A few informants referred to larger landowners sometimes using solar powered fans to help in the storage of onions; however, this is a relatively recent change and is restricted to those who can afford solar power. Some women reported sun-drying onions (and tomatoes and potato slices), but this is on a small scale and entirely for domestic consumption. Simply improving the insulation properties of storage using what are termed zero-energy cold storage facilities was seen by informants as the most desirable opportunity.

Q5: What are the constraints to existing storage/processing practices in terms of effectiveness, scale etc.?

The improved zero-energy cold storage facilities were seen by all respondents as a significant improvement on customary practices. However, the delivery of these facilities through projects and the Ministry of Agriculture has targeted individuals who have land and crop surplus, making them a private asset. These beneficiaries were also widely reported to be well connected and influential people in the village and the district. The interview responses make clear that access to these facilities by others depends on social relationships and, given the structures of social life in the Laghman villages, that access is not assured for many. At the time of the study, none of the sample villages had a community cold storage facility and there were no reports of any attempts to introduce these. This absence at the community level may be a key limiting factor to the scale of benefits that could be achieved from such cold storage facilities.

TABLE A 2. LAGHMAN INFORMANTS

Household code	Village	HH size	Land size (jeribs)	Owner/ sharecropper (SC)	Income source 1	Income source 2	Income source 3	Months food provisioning
AL_HH01	AL_V1	35	15	Owner	Employment	Farming		12+
AL_HH02	AL_V1	13	10	SC	Farming			10–12
AL_HH03	AL_V1	8	7	SC	Farming			12
AL_HH04	AL_V2	10	6–8	Owner	Farming			12
AL_HH05	AL_V2	9	5	Owner	Farming	Daily wage labour		Up to 8
AL_HH06	AL_V2	11	5	1.5 Owner, 3.5 SC	Farming	Daily wage labour		Up to 5
AL_ACCI	-	-	-	NGO				
MH_HH01	MH_V1	22	8	Owner	Work in construction company	Land	Rickshaw	12
MH_HH02	MH_V1	18	2.5	Owner	Farming	Livestock		10
MH_HH03	MH_V1	2	6	SC	Farming	Livestock		12
MH_HH04	MH_V2	17	7	Owner	Farming	Construction work	Livestock	12
MH_HH05	MH_V2	9	8	4 Owner, 4 SC	Farming	Imam of Masjid		9
MH_Elder1	-	13	3	Owner	Farming	Livestock	Poultry	Up to 8
MH_Elder2	-	12	< 1					
MH_NGO				NGO				
MH_Trader1								
MH_Trader2								
QG_HH01	QG_V1	11	3	3 Owner, 7 SC	Agriculture			12
QG_HH02	QG_V1	16	8	SC	Agriculture			Up to 10
QG_HH03	QG_V1	18	8	2 Owner, 6 SC	Agriculture			12
QG_HH04	QG_V2	10	2	SC	Agriculture	Daily wage		Up to 8
QG_HH05	QG_V2	12	5	SC	Agriculture			Unknown
QG_NGO								

Source: The authors

ANNEX 3. HERAT

Context

Herat province in the west of Afghanistan shares borders with Iran and Turkmenistan. It is one of four major centres that, historically, have made up Afghanistan's political strongholds, the other three being Kandahar in the south, Balkh in the north and Nangarhar in the east. What these centres have in common is a rich agricultural hinterland based on river-irrigated agriculture and a border location to the outside world. Economically, Herat is frequently portrayed as one of Afghanistan's most stable and prosperous provinces. It has benefited from a relatively open relationship with Iran, in terms of trade and labour migrants.

The AREU study was carried out in three districts of Herat located along the Hari Rud river, the principal river in the province. The upstream districts which lie east of Herat City are more reliably irrigated than the downstream districts and the two upstream districts of Pashtoon Zarghoon and Guzara, although there are annual fluctuations in the river flow. Pashtoon Zarghoon, the most easterly of the districts, is predominantly Pashtoon Zarghoon as the name suggests, and Guzara is located adjacent to Herat City. A third study district, Ghoriyan, is located downstream and west of Herat City and has been severely affected by drought. Two villages were sampled in each district (see Table A 3). The villages in Pashtoon Zarghoon and Ghoriyan are single crop villages, while the Guzara villages both have double cropping. Representatives from a total of 16 households were interviewed in the province. As with the other provinces, the men from the households were interviewed in person in the field while the women were interviewed by phone by female members of the AREU research team. In addition, five informants were included in the interviews – two traders, officials from the local chamber of commerce and the Ministry of Agriculture and two NGO workers.

Table A 3 provides summary information on the Herat informants, including their household size, farm size, access to land through ownership or sharecropping, sources of income and the number of months that they can self-provision the household from own-farm production. Key points to note across the 16 households include: the variation in household size (maximum 25, minimum 5, median 10) with the larger households (more than 10 individuals) being joint households; the range of farm sizes; the smaller number of households sharecropping to access land (3 of the 16 households) compared to Laghman; and the months of self-provisioning for the households from the land that is farmed. Four of the 16 households reported that they could not meet their annual basic household food needs from own-farm production. All of the interviewed households reported that agriculture is their first source of income although remittance income is an important secondary income source.

It should be borne in mind that the survey specifically targeted farmers and, consistent with findings from other studies (see Pain and Huot, 2018), there are high but variable levels of landlessness in the often-large Herat villages. In Pashtoon Zarghoon (PZ_V1) with 800 households, it was reported by informants that 10% are landless but many more than that depend on remittance income to survive. In the second village in the district (PZ_V2), of the estimated 1,100 households about 40% were reported by informants to be landless and again remittances are a significant element of the village economy. The first village in Guzara is small

(60 households) and most households engage in agriculture; but in the second large village (GZ_V2), of 700 households only 20% have been reported to have land. In Ghoriyan district, in the first village (GH_V1), again only 20% of the 200 households have land while in village GH-V2 some 90% of 300 households have land.

Existing practices

Q1: What are existing household and village post-harvest storage and food processing practices, for what agricultural products (vegetables, fruit, nuts, livestock products), at what scale, who (and from what sorts of households) undertakes them, and how effective (losses) are they seen to be?

Compared to the other two study provinces, Herat and the study districts within it grow a much wider range of crops, although there are differences in the crop portfolios between the villages, determined by access to irrigation water. The crops include the grain staples of wheat and some rice, grapes, onions, potatoes, tomatoes, a range of vegetables, mung beans, beans, sesame, saffron and asafetida. There has long been a commercial economy in Herat around the sale of fresh grapes and raisins, but more recently there has been more commercial production of onions and potatoes, while new crops such as saffron and asafetida have been grown specifically for the market. This reflects a more general commercialisation of the agrarian economy in the province, as indicated by the view of one NGO worker (GZ_NGO1), who commented how 15 years ago livestock products were not sold due to a moral economy (of providing surplus to those in need) 'but nowadays most people sell their milk, yoghurt, butter and cheese because of the market need'. The comments of other respondents suggest that this moral economy still exists; however, there has clearly been a shift. In part this has been driven by the emergence of factories in Herat City with processing facilities for milk and other livestock products to meet urban demand, which also provide opportunities for import substitution of commodities that have traditionally been imported from Iran (although there has long been a practice of Iran undercutting Herati prices if their market share has been threatened).

With respect to wheat and rice, storage practices in Herat are consistent with those of these grains in the other provinces – putting the grains in sacks in a dry, cool room with regular checking – and losses were reported by interviewees to be relatively low. According to one respondent (GZ_NGO), a small-scale intervention was established in 2022 supported by the United Nations Food and Agriculture Organization (FAO) to introduce metal storage bins for wheat (about 20–30 per district), but they commented that the bins were too small to store the full needs of a family for one year and they felt the project was unlikely to have had much effect due to such limited distribution.

For potatoes and onions, many of the respondents (especially those with fewer than three *jeribs* of cultivation) grew produce primarily for their domestic needs and they followed customary practices of storage – keeping them in the corners of rooms and regularly inspecting them. Over several months of storage, losses could be considerable at up to 50% of the crop. Those with more than three *jeribs* had the opportunity to benefit from the NHLP programme and be provided with improved cold storage. Those without access to these facilities faced the same challenge as the Laghman farmers – being forced to sell at the time of harvest when prices were lowest because of storage losses and then having to buy back for consumption needs when prices were higher. In 2023, however, the market price of onions has been higher because of a strong export market to Pakistan where crops have failed due to the floods there.

Three of the villages, (PZ_V2, GZ_V2 and GH_V1) grow grapes, although respondents in GH_V1 reported that grape production had been severely affected by water shortages. There has long been a good market in Herat in fresh grapes, as well as in raisins produced through a traditional method of processing. This is a process of scalding (or *abjosh*) the fresh grape to hasten drying to produce a high-quality raisin. The black and red raisin grape varieties (*aftabi*) are then directly dried in the sun while the green raisin grape varieties (*kishmish*) are dried in mudbrick drying houses away from the direct sunlight. The *abjoshi* process is still practised in Herat because of the quality of the product, but more recently new raisin processing facilities have been provided to individual growers through the NHLP (the 250,000 Af\$ costs are shared between the grower and NHLP on a 30%/70% basis). Households with vineyards are among the wealthier village households in Herat province: one interviewee (GH_HO3) described how he divided his grape harvest, with one-third going for household consumption, one-third to *abjoshi* processing for raisins and one-third being processed in his NHLP facility.

Saffron, as noted above, is a relatively recent crop, having been introduced as an alternative crop to opium poppy (although opium poppy cultivation was never widespread in the irrigated districts of Herat). The cultivation of saffron, entirely for the market, has taken hold in Herat in part because of the high-value market. Furthermore, it has been promoted as a crop that can enhance women's participation in economic activities. However, saffron is a semi-perennial with high capital investment costs and returns that are only significant from the second year onwards. It is more likely to be grown by farmers who can easily meet their subsistence requirements, and who have sufficient land area or other sources of income to handle the risk of investment.¹ Saffron is, therefore, less attractive to households that have insufficient land to be food-secure or that have limited sources of other income. Those who grow it have benefited considerably; they tend to be male farmers with larger landholdings. There are also examples of women who have gained a foothold in saffron production through land inheritance or access to land through relations or leasing.

Saffron has been promoted because of its potential to generate employment, particularly for women on the harvesting and processing side. Around 5,000 women and children are hired every saffron harvesting season to clean and process saffron flowers. This work is generally piece rate and significantly lower paid than comparable work by men. Indeed, a common justification for the use of women is that they can be paid less. A contributory factor to the employment of women may be that the short harvest season with high labour demand cannot be met by the available male labour supply, as many men migrate to Iran for work. Women's work in saffron processing usually takes place in spaces designated for women, and there are some examples of women moving from one village to another to undertake this work. However, the short-term nature of employment and the low rates do not offer a living wage or significantly change the employment constraints women face. The processing itself is labour intensive, involving picking the flowers, separating the stamens from the flowers, cleaning and sorting them, and then drying them. This must be done in a short period of time to maximise the value of the crop.

In addition to women's involvement in saffron, in common with the findings from the other provinces, there are also well-established practices carried out by women for the drying of various vegetables (for example, okra, eggplants, mint and tomatoes) and the processing of tomatoes into paste or pickles.

1 This discussion draws on Minoia and Pain (2016).

At a general level, there appears to be a more mixed picture in Herat concerning the role of women in agricultural production, partly exemplified by women's labour around saffron, and more of a commercial economy around livestock products in which women are also engaged. In PZ_V2, women were reported to also work in the grape harvest, although it is possible that because many grape gardens are walled, this is seen to be an acceptable practice with regard to social norms around the visibility of women in society. In contrast, in PZ_V1, a village that has long been under Taliban control, women are scarcely seen in public spaces.

Q2: If crop surpluses/processed products are sold, who sells them, where (and how far) and to whom are they currently sold and in what quantities? What income is generated from this? What changes over the last ten years?

In the villages in Guzara – both of which are double cropped and close to Herat City – households with land and an agricultural surplus can readily sell to meet urban demand and production. There is a more commercialised approach, particularly around vegetables and livestock products, the latter being a notable income source in comparison with the villages in the other two sample districts. But even here, as one female respondent (GZ_H01F) made clear, the selling of surplus is driven by the need to avoid crop loss and so prices are low rather than having a strong commercial orientation: 'we sell the harvest due to not having quality storage. We sold one seer (4 kg) of onions for 100 Afs in the harvest season and now we are buying it at 200 Afs per seer'.

Pashtoon Zarghoon district is about 40 km from Herat City but village PZ-V1 is on the asphalted road that links the district to the provincial capital. Thus, there is ready physical access to the city that facilitates the sale of grape and raisin produce. In contrast, PZ_V1 is about two hours from the district centre, on a rough dirt road, which severely limits opportunities for the sale of any surplus produce to the district centre, let alone to Herat City. Ghoriyan district is about 70 km from Herat City. The two sample villages there are both single cropped and suffering from lack of access to water. As noted earlier, only a minority of households in GH_V1 farm and even these have limited surplus, while GH_V2 is more of an agricultural village with the two key crops that are sold being onions and saffron.

Much of the taking to market and selling of produce, particularly of onions and vegetables but also livestock products, is done at an individual level and mostly by men. In the case of grapes and raisins and also saffron – which, as noted, are grown by farmers with larger landholdings – there may be direct connections to city traders who will buy the products direct from the farm. Women may sell at a small scale and at the village level sell livestock products to relatives and neighbours. However, at a household level, it appears that the management and processing of livestock products is under the control of women, and even if men do the selling, women are entitled to at least a portion of the income raised as their own income over which they have control.

Post-harvest storage facilities

Q3: Who constructed, who owns, and who is responsible for the maintenance of these storage facilities? Who is eligible to use these facilities, and under what conditions?

As observed earlier, there have been various interventions in Herat with respect to post-harvest processing and storage. One has been the recent introduction by FAO of improved storage bins for wheat, but this has happened on a very small scale. Raisin processing units have been constructed too: according to a Ministry of Agriculture informant (GZ_DAIL), over 1,300 of these have been built in the province, and in the sample villages with grape gardens several were reported to be present. Much smaller numbers of improved onion storage facilities have been built in the province (about 400 units according to the same official) and about 20 additional units have been built for potatoes. These facilities were reported to have all been implemented through the NHLP programme.

However, in all cases, these improved storage facilities were reported to have been installed for larger farmers and those meeting a minimum crop area criterion. This means that many smaller farms, often growing the crops primarily for subsistence purposes, have not been included in the programme. This bias towards larger farmers has neglected the importance of improved post-harvest storage for household subsistence. As in the other provinces, while relatives and neighbours might get access to these storage facilities, households without those familial or social connections do not.

Q4: What energy sources, e.g. sun, solar power, bio-gas, etc., are used for any processing and have these changed?

All the processing and storage facilities that have been built at the farm level in Herat province have been zero-energy, relying on better aeration or improved insulation to lower humidity and temperatures. There is mains electricity in one district, however. One household (GH_H03) from village GH_V1 reported that they had 24-hour electricity, which was generally reliable, and that there was also potential to use solar energy but no storage facilities have been designed for use with this energy source. While solar energy was reported to be widely used in all villages for lighting purposes, landowners with grape gardens in GH_V1 use solar powered water pumps too.

Q5: What are the constraints to existing storage/processing practices in terms of effectiveness, scale etc.?

The findings on constraints for storage and processing practices in Herat are consistent with those found for Laghman with improved storage facilities offering a significant improvement over customary practices for those who had access to them. But it was primarily larger farmers who benefited from them. Herat however is an important province for grape and raisin production but again it is only farmers with land and access to irrigation that grow this crop.

TABLE A 3. HERAT INFORMANTS

Household code	Village	HH size	Land size (<i>jerib</i>)	Owner/ sharecropper (SC)	Income source 1	Income source 2	Income source 3	Months food provisioning
GH_HH01	GH_V1	13	50	Owner	Agriculture	Mirab ^a		12
GH_HH02	GH_V1	12	18 (Rf) ^b	Owner	Agriculture	Remittance		<5
GH_HH03	GH_V1	15	40	Owner	Agriculture	Livestock	Salary	12
GH_HH04	GH_V2	8	6	Owner	Agriculture			10
GH_HH05	GH_V2	5	10	Owner	Agriculture	Livestock	Remittance	12
GH_HH06	GH_V2	10	30	Owner	Agriculture	Livestock		12
GZ_HH01	GZ_V1	16	5.5	Owner + SC	Agriculture	Livestock	Labour	12
GZ_HH02	GZ_V1	5	6	Owner	Agriculture	Remittance		12
GZ_HH03	GZ_V1	10	10	Owner	Agriculture			12
GZ_HH04	GZ_V2	10	5	SC	Agriculture	Remittance		10
GZ_HH05	GZ_V2	7	12	Owner	Agriculture	Salary		12
GZ_elder1								
GZ_elder2								
GZ_ACCI								
GZ_gov1								
GZ_gov2								
GZ_gov3								
PZ_HH01	PZ_V1	25	20	Owner	Agriculture	Remittance		12
PZ_HH02	PZ_V1	8	5	Owner	Agriculture	Remittance		6
PZ_HH03	PZ_V2	10	9	Owner	Agriculture			12
PZ_HH04	PZ_V2	18	7	Owner	Agriculture	Salary	Shop	12
PZ_HH05	PZ_V2	14	15	Owner	Agriculture	Salary		12

Notes: (a) Mirab is a village-level water steward; (b) Rf refers to rainfed land

Source: The authors

ANNEX 4. BADAKHSHAN

Context

Badakhshan is a mountainous borderland province in the north-east of Afghanistan, sharing a border with Tajikistan, China and Pakistan. To the south, the Hindu Kush mountain range cuts off the province from the rest of the country. In the past, seasonal access to Badakhshan was restricted to one pass, which connected it and a significant livestock trade through the Panjshir Valley to Kabul. Now there is one motorable road into the province from Takhar province, which is subject to closure during winter. A mixed marginal single crop economy of wheat production, tree and fruit products and livestock has been central to survival in a landscape where settlements in valleys and high plains stretch from 1,000 m to 3,000 m above sea level. This has led to a marked seasonality in production determined by temperature. There is river irrigation in the main mountain plains.

Many of Badakhshan's higher settlements have historically seen grain deficits with supplies achieved through seasonal labour migration or through the sale of livestock. In the lower areas, grain supplies have been secured through opium production (which has long been a staple crop in the province – see Bradford, 2014), livestock sales and seasonal labour in other provinces, as well as through work in the province's lapis lazuli mines. The province has a history of chronic food insecurity and in 2005 was assessed as having one of the highest proportions of households living beneath the poverty line of any Afghan province (CSO, 2006).

The AREU study was carried out in three districts – Baharak, Faiz Abad (which contains the provincial capital) and Jurm. Two villages were sampled in each district (see Table A 1). Representatives from a total of 15 farm households were interviewed in the province. The men from the households were interviewed in person in the field while the women were interviewed by phone by female members of the AREU research team. In addition, seven informants were interviewed, including one trader, NGO workers, a government official and village elders.

Land ownership distribution, social structures and irrigation sources differ between the sample villages. The levels of landlessness reported by informants range from 10% to 80% of households in the six study villages. In the first of the Baharak villages (BH_V1), some 10 km from the district centre, about 40 of the 60 households (66%) are landless, although they may sharecrop in land from the landowners. Twelve landowners have more than 30 *jeribs*. However, the land is unreliably irrigated from a seasonal river. The second, larger Baharak village (BH_V2) has 180 households and lies about 20 km from the district centre. Here, 80% of households are landless, surviving on remittances from Iran and labour in a local gemstone mine. Irrigation water supply here is also seasonal and limited. In Jurm, the first village (JM_V1) is in the centre of the district. It has 84 households and only 8 (10%) are landless. The village is reliably irrigated from the Kogcha river. The second village (JM_V2) is closer to the district centre and larger, with 320 households. Here, about 30% of households own land, a further 20% access land as sharecroppers and the remainder are either traders in Jurm town or work as casual labourers. There is a small group (five) of large landowners who own more than 30 *jeribs* of land. In Faiz Abad, the first village (FB_V1) has only 30 households and is rainfed; five households have no land. But agriculture is marginal and daily wage labour and remittances

are key income sources. The second village (FB_V2), with over 100 households, has both irrigated and rainfed land. There are few landless households in the village. Nevertheless, daily wage labour and remittances are important income sources for many households.

Table A 4 provides summary information on the Badakhshan informants, including their household size, farm size, access to land through ownership or sharecropping, sources of income and the number of months which they can self-provision the house from own-farm production. Key points to note across the 15 households include: the variation in household size (maximum 25, minimum 6, median 10) with the larger households (more than 10 individuals) being joint households; the range of farm sizes; the smaller number of households sharecropping to access land (5 of the 15 households) compared to Laghman; and the months of self-provisioning for the households from the land that is farmed. Eight of the 15 households reported that they could not meet their annual basic household food needs from own-farm production. Four of the farm households reported that salary income is their first source of income – for all others it is agriculture supplemented with income from livestock and on- and off-farm work.

Existing practices

Q1: What are existing household and village post-harvest storage and food processing practices, for what agricultural products (vegetables, fruit, nuts, livestock products), at what scale, who (and from what sorts of households) undertakes them, and how effective (losses) are they seen to be?

The portfolio of agricultural products in Badakhshan is distinctive with no rice being grown, a greater emphasis on tree fruit crops (walnuts, apricots, cherries and apples, etc.), the cultivation of melon and beans, and a greater contribution of livestock products to the diet, in addition to the range of vegetable crops (potatoes, onions, tomatoes, etc.) found in the other two provinces. It should also be noted that Badakhshan, with its cooler temperatures, has a more favourable climate for crop post-harvest storage than either Herat or Laghman. Indeed, the great risk for the more perishable crops such as potatoes is that of frost damage.

As with the other two provinces, post-harvest storage of grain in Badakhshan can be distinguished from that of other agricultural products, given the nature of grains and their contribution to subsistence. Traditionally, wheat is stored in sacks in a cool and dry place and there were no reports, as in Laghman, of chemical treatment being required to control pests although rodent damage does happen. One household (BH_HH01) reported that it could store wheat for up to two years in this way without significant crop losses, although many of the households reported that they have at times exhausted their wheat stores well before the next harvest and had needed to buy in wheat to meet deficits.

One household in Jurm (JH_HH04) reported that there has been a shift from the traditional practices described above to the use of tin barrels or containers for wheat – a practice learned from Iran – and that this has improved wheat storage. As in the other provinces, the role of women in wheat processing is confined to the cleaning and storage of the grain. Beans are grown by 12 of the informants, who reported that they store the produce in sacks for up to two years with little loss. Among households that could not meet wheat needs from their own production, there were no reports of sales although beans could be sold to meet other household requirements.

Most of the households grow potatoes, onions and tomatoes, as well as other vegetables. Three of the five households in Baharak grow melons as a cash crop, which they do not store, taking advantage of their location by a roadside. Badakhshan's more favourable climate compared to Laghman means that the shelf life of fresh agricultural products is longer: no farmer reported the pressures of having to dispose of immediate surplus of annual crops at harvest or to otherwise waste surplus crops. However, for apple and cherry harvests, for example, interviewees reported that there is pressure to sell at harvest if they choose not to dry the product. Traders from Kabul are the main buyers of these products.

There are traditional practices of storage in the case of potatoes and onions. For potatoes, pits or clamps are dug and potatoes can be stored for a period of up to six months, with farmers facing losses of about 25%. They reported that most of the harvest has been spoiled in these pits or clamps during very cold weather. However, as one informant noted, the crops could still be sold then or used as seed potatoes. The only danger is from severe frost when losses can increase if the protection of potatoes is not sufficient.

As discussed below, respondents reported that improved cold storage facilities for potatoes have been built in the district but none of the informants have used them. They observed that the facilities had not been completed or were of poor quality and were damp, or in most cases they have been built for individual farmers and were not accessible to others. In the case of onions, there are also customary practices of storage including stringing them up and hanging them in the kitchen where wood smoke helps to preserve them. In this way, onions can be kept for up to six months over the winter period with relatively little storage losses. One interviewee (BH_H05M) reported that, in some cases where production is good, a proportion of the harvest may be sold directly from the field to traders. There were no specific reports of onions or potatoes being dried as a form of storage.

There were mixed reports from the households about the division of household labour. In some cases, the comment was made that women are not involved in the cultivation of crops. But in others (BH_H03M), a male respondent was very clear that women 'liked to be involved in the cultivation of onions and jointly work in irrigation and collection of the harvest'. Many households reported that tomatoes and eggplants are often dried as a form of storage and many women make tomato paste or pickle and might sell a small amount of surplus at a local level. Women are also active in the drying of cherries, apples and apricots when these are not sold as fresh products. There were also reports by some of the women that they make and sell jam from the fruits, with one woman reporting that they had generated about 1,750 Afis in the current year from selling these products. As in other provinces, women have a particular role in the processing of livestock products such as yoghurt, milk and *qurot* (dried yogurt, which can be stored for a long period). Indeed, there has long been a practice of seasonal migration to higher-altitude pastures in the mountains by both men and women, where women stay milking the livestock and making livestock products.

Q2: If crop surpluses/processed products are sold, who sells them, where (and how far) and to whom are they currently sold and in what quantities? What income is generated from this? What changes over the last ten years?

Unlike in other provinces, in Badakhshan the perishability of vegetable crops is not a strong driver for households to sell immediate surplus at harvest. Indeed, the province has a long history as a remote food-deficit mountain economy that, outside the trade of livestock and its products, has restricted the sale of agricultural products outside the province. Instead,

most surplus sales are to a very local economy. As elsewhere, however, the sale of products is largely carried out by men and such sales primarily relate to the need to meet immediate household needs. Such sales are not necessarily on a cash basis and surpluses may be bartered for other commodities with shopkeepers or mobile traders who are common in the province. One informant (JH_HH05) reported that their bean crop is their main currency of exchange with the local shopkeeper.

While any surpluses are sold by men, several women reported that they regularly used their children to sell fresh milk in the local markets. Women can sell surplus locally within a village to relatives, but their ability to sell in commodity markets beyond villages appears to be more limited. However, a close reading of the transcripts from female and male respondents on this issue suggests that while the official narrative is of a sharp division between what men and women do, in practice the accounts from women indicate that they can be more engaged in surplus sales than the men suggested. One woman (JM_H05) was quite emphatic on this point: 'I plant some vegetables in my house ... I sell half of them to the market ... I sell some of the dried apricots if they exceed our winter use.'

Post-harvest storage facilities

Q3: Who constructed, who owns, and who is responsible for the maintenance of these storage facilities? Who is eligible to use these facilities, and under what conditions?

As noted earlier, there has been limited construction of improved cold storage facilities in Badakhshan. The NHLP has reportedly built several structures and one of the informants (BH_elder) has been a beneficiary of this. He complained that it was poorly built and damp and that he could not use it. Another informant from the same village (BH_H01M) noted that three improved cold storage units have been built by NHLP in the village, one each for onions, apples and potatoes, but that they selected those farmers with the largest harvest and who could contribute to the cost of construction. In a comment echoed by others, he said that the beneficiaries 'used their relationship with the government and the NGO to allocate that cold storage to him'. This means that the facility is not available to other farmers to use unless they are a relative or neighbour of the beneficiary.

An Informant from the Ministry of Agriculture (FA-DAIL) confirmed that the storage facilities had been made for the big landowners but he then went on to say this was determined at the Kabul level and that it was out of their hands. However, since the change in regime in August 2021, the NHLP project has been suspended and several facilities have been left incomplete. In contrast, in the second village one woman (FA_H03M) reported that a different NGO has installed three cold storage units in the village and that these are not targeted to individual households but instead are for all the village households to use. According to a second informant (FA_H05M), each cold storage unit is for 75 families who pay a monthly fee of 400 Afs towards the salary of a guard and the maintenance of the facility.

For those who reported that they have had access to improved cold storage, it seems that these facilities have not led to a dramatic reduction in post-harvest losses, although they were seen to be better facilities than the customary ones. In part, this may reflect the fact that, in comparison with Laghman, there were not consistent reports in Badakhshan about dramatic price fluctuations over the season, which is probably a consequence of the less commercial and marginal agricultural economy of the province.

Q4: What energy sources, e.g. sun, solar power, bio-gas, etc., are used for any processing and have these changed?

Badakhshan has very limited grid electricity and all improved storage facilities that have been constructed have no energy source. There were no reports of the use of solar power as an energy source. Given the mountainous terrain, hydro power may offer the one major opportunity for off-grid power sources.

Q5: What are the constraints to existing storage/processing practices in terms of effectiveness, scale, etc.?

Several points can be made here. First the climatic conditions of Badakhshan with its cold winters reduce the challenges of post-harvest storage, although, as a corollary of this, a single cropping season makes post-harvest storage of surplus all the more important if the primary focus of households is – as it appears to be – on meeting subsistence needs. Customary practices concerned with the storage of household staples (wheat, potatoes and onions), supplemented with the drying of seasonal vegetables and fruits, appear to sufficiently meet the needs of many if not all households. The improved post-harvest storage facilities that have been introduced in the province may contribute to meeting the subsistence component of living but, according to reports, in many cases these programmes have prioritised individual large farmers and the facilities have not been seen as a village public good.

TABLE A 4. BADAKHSHAN INFORMANTS

Household code	Village	HH size	Land size (jerib)	Owner/ sharecropper (SC)	Income source 1	Income source 2	Income source 3	Months food provisioning
BH_HH01	BH_V1	19	10	Owner	Salary	Salary	Agriculture	12
BH_HH02	BH_V1	8	5.5	1.5 Owner, 4 SC	Agriculture	Livestock		10
BH_HH03	BH_V2	18	5	1 Owner, 4 SC	Salary	Labour	Agriculture	8
BH_HH04	BH_V2	10	4	Owner	Agriculture	Livestock		8
BH_HH05	BH_V2	6	3	Owner	Agriculture	Labour		6
BH_Elder								
FA_HH01	FA_V1	14	14	Owner	Agriculture			10
FA_HH02	FA_V1	10	1	Owner	Agriculture	Labour		6
FA_HH03	FA_V2	15	16	8 Owner, 8 SC	Agriculture	Livestock		12
FA_HH04	FA_V2	25	8	3 Owner, 5 SC	Agriculture	Livestock		12
FA_HH05	FA_V2	18	8+30 (Rf)	Owner	Agriculture	Livestock		12
FA_NGO1								
FA_NGO2								
FA_ACCI								
FA_DAIL								
FA_Trader1								
FA_Trader2								
JH_HH01	JH_V1	4	7	Owner	Salary	Agriculture		12
JH_HH02	JH_V1	8	1	SC	Salary	Remittance	Labour	5
JH_HH03	JH_V1	8	8	Owner	Agriculture			12
JH_HH04	JH_V2	13	8	Owner	Agriculture			12
JH_HH05	JH_V2	8	1	Owner	Agriculture	Labour		8
JH_Elder								

Note: Rf refers to rainfed land

Source: The authors

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