# Estimation of private stock of food grains in Bangladesh: Data sources and methodological issues

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# Executive Summary

Empirical studies to explain the reasons behind the 2007-2008 price volatility in the global food grain markets showed that among other factors, food grain stock especially stock-to-use ratio, was a major factor in price volatility. It has also been found that current data on stock at both global and national levels are inadequate, of poor quality and there is much to gain from investing in improving its quality for better understanding the price volatility in food grain markets and for take more appropriate policy decisions. Efforts are currently underway through a global project on Agricultural Market Information System (AMIS) for improving the mechanism of collection and dissemination of food grain stock data.

This study has been conducted as a part of that project implemented in Bangladesh. Past efforts in the collection and dissemination of food grain stock data in Bangladesh and their conceptual and methodological strengths and weaknesses have been reviewed with a view to identify data gaps, methodological deficiencies and suggest measures required for improvement.

The review revealed that currently there is no mechanism for regular collection and dissemination of food grain stock data in spite of its usefulness in the formulation of food policy and monitoring food grain markets and prices. A template previously used by the Food Policy Monitoring Unit at the Ministry of Food for estimation of month end aggregate private and public stocks is no longer in use. However, FPMU still releases monthly public stocks of food grains as part of monthly monitoring report on food grain production, disposal and prices but the methodology for stock estimation is not published. The only other source of macro-level stock data is the Household Income and Expenditure (HIES) survey conducted by the Bangladesh Bureau of Statistics (BBS) on a nationwide sample every four or five years. But the quality stock data is poor in this multi-purpose data heavy survey. Various stand-alone surveys conducted in the past at different points in time focused mainly at the producer level as part of grain marketing studies, some covered specific trader type but rarely all agents in the supply chain from households through domestic private traders, processors and private importers of the grain to consumers. Such studies also had several conceptual and methodological deficiencies. Being sporadic with small sample size and geographical coverage, these survey results have location specificity, hence are not always suitable for extrapolation to the national level.

The accuracy of the economy-wide monthly stocks depends on the accuracy of the parameters and the assumptions made about gross and net production, marketed surplus and sales pattern by month, population, per capita consumption as well as estimates on carryover stocks, domestic procurement and disposal. There is hardly any consensus on the accuracy of the available statistics on these parameters either from nationwide or from sample surveys. Recommendations have been made on mechanism of good quality stock data collection using proper conceptual and methodological approaches.

# 1 Background and Objectives

Intra- and inter-annual price fluctuations are general features of agricultural commodity markets. Unusually high fluctuation may become a cause for concern as such fluctuation may adversely affect producer and consumer welfare with implications for public policy interventions. Since the early 1960s, four major spikes followed by troughs occurred in the global food grain market – one in the mid 1960s, one in the mid 1970s, one in the mid 1990s and one in 2007-08 (Bobenreith et al., 2012). After 2005, agricultural commodity prices experienced a general boom for a long period since World War II reaching a peak in 2011. Prices have now come down but are still about 40% higher in real terms than their 2000 lows (Baffes and Haniotis, 2016).

The nature of these agricultural price cycles and their drivers has been a subject of inquiry and debate in recent years. Different studies used different sets of factors to explain the fluctuations. Most commonly identified factors include weather shocks, global warming and/or technology slowdowns that reduce yields and increase production costs, energy prices, speculation, global demand, and real effective exchange rate. A few studies e.g. Bobenrieth et al. (2012), Ott (2014), Baffes and Haniotis (2016) highlighted the role of stocks or stock-to-use-ratios, along with other factors, in explaining price volatility in the global food grain markets. And given the current deficiencies in stocks data, Bobenrieth et al. (2012) emphasized the importance of improving the quality and accessibility of stocks data to understand and address future volatility in global food grain markets.

Partly in response to such concerns, at the request of the Agriculture Ministers of the G20, the Agricultural Market Information System (AMIS, http://www.amis-outlook.org) has been created as an inter-agency platform to enhance food market transparency and encourage coordination of policy action in response to market uncertainty. The initial focus of AMIS is on wheat, maize, rice and soybeans. AMIS seeks to strengthen collaboration and dialogue among main producing, exporting and importing countries. Apart from G20 members plus Spain, participants in AMIS include seven major producing, consuming and exporting countries of the commodities covered by AMIS. Together, these countries represent a large share of global production, consumption and trade volumes of the targeted crops. In addition, AMIS reaches out to other key stakeholders in international food markets such as commodity associations and institutional investors in commodity markets.

AMIS has five main pillars that reinforce each other - market monitoring, market analysis, generation of statistics, 4capacity development, and outreach and policy dialogue. The objectives of activities under the Statistics pillar are to assemble the latest and most reliable data on production, trade, utilization and stocks for the four AMIS commodities.

Like many developing countries, the overriding objective of national food policy in Bangladesh is to ensure food security in all its dimensions for its population. To that end public policies are formulated and implemented with respect to domestic production and procurement, import and disposal of food grains. In so far as the domestic market is linked with the global market for food grains and production inputs like fertilizers and fuel, volatility in the global market will spill into the domestic market with consequences for its food policy objectives. Within the domestic market, among other factors, the nature and extent of public and private stocks of food grains play different but inter-related key roles in functioning of the food market.

The objectives of public food grain stocks are a combination of creation of a buffer stock, a security stock, meeting emergencies due to natural calamities and to intervene in the market alongside the private sector to ensure a socially optimal level of stock over time. On the other hand, private stocking of food grains as an activity takes place with households and traders of different types linking producers and consumers with different objectives.

Among households, there are differences between food grain producing and non-producing households in terms of stocking objectives. Food grains are harvested at specific times during a year but consumed over longer periods. So producers need to maintain stocks to smoothen consumption. For example, Islam et al. (1987) found in their survey of 2000 farms in 1982-83 that 76.9% of total supply of rice (92.8% of total production) was stored for varying length of time, from a few days up to several months, which implied that farmers had working or operating stocks mainly for consumption. Moreover, all or some producers may sell part of the produce, so the nature, extent and duration of stock will depend on consumption needs and the expected pattern of sales – volume and time of sale and related reasons, e.g. sales to generate cash irrespective of the price level or sales in response to market price to maximize profit. On the other hand, households producing insufficient quantities for own consumption and non-producing rural and urban households may buy and stock food grains of different quantities for different mostly short durations depending on present prices and their perception and expectation about future prices. The objective of stocking in this case is primarily to avoid having to buy at an unreasonably high price in the future compared to the current price.

Traders usually stock for temporal arbitrage, i.e. to benefit from differences in the current purchase price and sale price at a future date. Traders may operate only in domestic market while others may be involved partly or fully in international grain market. The actual inventories or volume, form and duration of their stock depends on the operational need of the type of business, e.g. simple speculative buying and selling, spatial arbitrage of different degrees and value adding activities like processing along with speculative buying and selling.[1] Sometimes public procurement programme for food grain is implemented partly through private traders under some arrangements or conditions, in which case the trader objective of temporal

[1] Normal stocking for speculative purposes in a competitive market environment is distinguished from 'hoarding' which is the situation in which one or more agents (normally few and large enough to control a large share of the market) stock to create artificial scarcity for the only purpose of pushing prices up above the levels expected under competitive conditions in order to realize super-normal profits.

arbitrage remains but its outcome may depend on the conditions imposed by the public procurement policy and terms of procurement.

Thus the nature and extent of private food grain stocks is dependent on a range of factors related to the structure of food grain production, consumption, marketed surplus, and pattern of marketing by producers and traders along the supply chain, and of the structure and conduct of food grain market (Chowdhury, 1993). The flow of food grains and prices in the market will depend on marketed surplus of producers and their marketing patterns as well as the stocking and marketing behaviour of various types of traders. A reasonably good estimate of private stocks of food grain over time is necessary for proper formulation and implementation of national food policy, specially policies on domestic food grain procurement, import and disposal. The importance of such information on private stock increases as the food grain economy expands both in terms of larger output from better technologies, and greater market participation by producers with larger marketed surplus. Such information is scarce in the country.

In view of the above, under its capacity development pillar, AMIS is currently supporting the Government of Bangladesh to improve the quality of generation and dissemination of her food grain market data including data on private stocks. Within the framework of that activity, this study is being conducted with the following objectives:

- To review existing data sources on food grain stocking in supply chain of principal food grains in Bangladesh - rice, wheat and maize , potential of their consistent use in assessment of food grain stock, and data limitations.
- To suggest a conceptual framework for assessment of food grain stocking behaviour
- To recommend approach and options for additional data collection with a view to getting accurate estimates for food grains stock at different points in supply line.

In section 2, some studies on price volatility in global food grain market are reviewed with a view to highlight the role of stock, especially the role of stock-to-use ratio in explaining price volatility. In section 3, available empirical evidence on private stock of food grains are summarized. In section 4, quality of the data sources and their conceptual and methodological deficiencies are discussed and options for improvement suggested. Conclusions are drawn at the end.

## 2 Role of Stock in Price Volatility in Global Food Grain Markets: A Brief Review of Some Studies

Following the 2007-8 food price crisis, a good number of papers have analyzed the nature and causes of price volatility in the global market, and their consequences. Such studies generated controversy both about the causes and consequences of price volatility in 2007 and 2008. A few of those are briefly reviewed below especially with a focus on the role of stock in price volatility.

Trostle (2008) showed that rising food demand, increased energy costs, a weak U.S. dollar, and other factors contributed to the rapid escalation of food commodity prices until July 2008 and further argued that the events were too complex to identify potential causal factors.

Naylor and Falcon (2010) analyzed international commodity price movements, assessed food policies in response to price fluctuations, and explored the food security implications of price volatility on low-income groups. It focused specifically on measurements, causes, and consequences of recent food price trends, variability around those trends, and price spikes. Combining these three components of price dynamics showed that the variation in real prices post-2000 was substantially greater than that in the 1980s and 1990s, and was approximately equal to the extreme volatility in commodity prices that was experienced in the 1970s. Macro policy, exchange rates, and petroleum prices were important determinants of price variability over 2005–2010, highlighting the new linkages between the agriculture-energy and agriculture-finance markets that affect the world food economy today. They concluded that these linkages contributed in large part to misguided expectations and uncertainty that drove prices to their peak in 2008. They also argued that there was a long-lasting effect of price spikes on food policy around the world, often resulting in self-sufficiency policies that created even more volatility in international markets. The efforts by governments to stabilize prices frequently contributed to even greater food insecurity among poor households, most of which were in rural areas and survived on the margin of net consumption and net production. Events of 2008—and more recently in 2010—underscore the impact of price variability for food security and the need for refocused policy approaches to prevent and mitigate price spikes.

Timmer and Dawe (2010) in a synthesis of papers presented at a conference on lessons learned from the rice price volatility during 2007-08 touched upon the role of speculation in rice futures market and storage policies of major and minor rice economies in the 2008 rice price hike. They argued that futures markets for rice are thinly traded and there is little opportunity for financial speculation in rice prices. The supply and demand fundamentals for rice were supportive of the gradual increase in the world prices from their lows in 2001, but production had been increasing steadily, stocks relative to use had been increasing since 2003, and supplies available for export were adequate for normal demand.

They further noted that rice stocks in India and China, the two large rice economies, had been reduced sharply between the late 1990 and the early 2000s as a conscious policy of both governments. These stock reductions seemed entirely rational in a situation of low and declining world prices and very high storage costs being incurred.

As rice prices began to rise after the lows in 2002, rice stocks also began to increase again consistent with modern ‘supply of storage theories’.

Therefore there was no plausible reason for a sudden surge in price, and indeed there was no surge until late 2007 shortly before the peak in wheat prices. Once the spiral started, rice prices shot up more rapidly than wheat or corn prices to a relatively higher peak in May 2008.

Referring to situations prevailing in a number of rice exporting and importing countries, they argued that in a situation of rapidly rising prices, higher futures prices might have affected expectations, and ‘localized’ storage decisions, among market agents who were not actively engaged in organized commodity markets. These localized decisions contributed directly to the speculative spike in rice prices during the 2007-08 food crisis.

Wright (2011) made a review of market events during 2007-08 and their economic interpretations and found that price spikes during these years were not as unusual as many discussions imply. Further, he argued that the balance between consumption, available supply, and stocks appeared to be as relevant for understanding of these markets as it was decades ago.

Abbott et al (2011), however, provided data from USDA’s WASDE reports showing that expected stocks appeared to be much larger during the crisis than would be suggested by the high market prices observed then. And argued that commercial interests at the time of the crisis viewed that the traditional stock-to-use relationships broke down during this crisis.

Bobenrieth et al. (2012) conducted a detailed analysis of the price behaviour in rice, wheat and maize markets and the market for the three grains together as a market for aggregate calories. The paper dealt with several methodological issues to explain grain price volatility, so it is reviewed below in some detail.

They started from the premise that information on the behaviour of global grain markets was scarce and of highly variable quality. Then they addressed the challenges of how best to utilize available imperfect global information, especially on global stocks, in order to strengthen global capacity to issue early warnings of possible price volatility, and thus enhance food security and emergency policy responses to threats to food security.

They used global price index data, recognizing its various limitations, because it was still the best available measures of the state of world’s grain markets. In order to understand the behaviour of prices, the authors have deflated all annual price data for the period 1960 to 2010 into real price indices using the annual Manufactures Unit Value Index (MUV) from World Bank/GEM Commodities. The report that the main feature of the behaviour of the real prices of all three grains is their general downward trends, which has been made possible by “remarkable success of plant breeders and farmers in continually developing and adopting new crop varieties with enhanced response to increased application of fertilizers, and to innovations in production and transportation of fertilizers that have greatly reduced their cost” (p.5). Further, the general downward trends are accompanied by moderate fluctuations with episodes of higher ‘volatility’ characterized as steep jumps in prices followed by precipitous falls back to the trend. However, these fluctuations are asymmetric as the troughs are less prominent than spikes.

They argued that though some of the studies reported energy price as a major factor in price volatility based on econometric results, the reason or logic behind this relationship is not clearly explained. Some studies argue that oil price led the grain price spikes of the 1970s and in 2007/08. Other analysts appear to believe that energy always leads commodity price surges, for which some evidence exist. But these authors argue that the relationship is not universal. For example “energy prices rose in the 1970s, but equally clearly they trailed grain price surges. Energy prices jumped again after grain price plummeted, then fell and remained fairly constant as grain prices continued to fluctuate during the 1990s. Energy had no role in the 1996 grain price spike. The recent energy price surge was the first to precede a spike in grain prices, a fact not obvious from annual data. …. Some analysis suggests that energy price raised grain prices via cost increases. While energy costs affect transport and processing costs of food and feed (tending to depress farm gate prices), a positive effect on grain prices at the farm gate could occur only if the cost increase made current grain production levels unprofitable, causing farmers to cut back acreage or chemical inputs, reducing output and driving prices up. Clearly this has not happened. Farm profits are at record levels, as are land prices. Further, as noted above, production has been at record levels in most recent years. Similar arguments that fertilizer prices have raised grain prices suffer from the same fundamental flaw: fertilizer use is high, keeping fertilizer prices high. If fertilizer input is not cut back, how can production be reduced, and thus price increased, via this route?” (p.11).

The authors argue, quoting Greenfield and Abbassian (2011) that though several assessments of the price volatility have tried to link price shocks to weather shocks, global warming and /or technology slowdowns that reduced yields and increased production costs, in reality it is not easy to establish the link between production variation and grain prices. They provide example of several occasions when output shortfall did not lead to price spike. They argue that to obtain an accurate view of price volatility, there is a need to remove the influence of the strong trends from measures of variation in real grain prices. In order to do so, they de-trended both prices and production of the three grains. The results show that production is not closely correlated with price, and price peaks do not necessarily coincide with the worst harvest years, which indicate that a significant production shortfall is neither necessary nor sufficient to cause a price spike.

They argue that although production fluctuation can have serious effects on agricultural markets, these effects are not as simple and direct as many studies assume. There are several reasons for this. First, markets for the three gains are distinct because of the different nature of their uses, but not fully independent because of possibilities of substitution in case of certain uses. Markers for substitutes in consumption or any other use may moderate the effects of production shortfall in any grain. The three major grains also compete for inputs such as fertilizer and land. Hence the possibility arises that an aggregate of the calories supplied by the three grains better reflects the state of the market for the major grains than does any of the three component grains. Second, storability of grains for a considerable period without excessive deterioration in quality can also moderate effects of production shortfall on price if adequate stocks are in place for drawdown to meet shortfall. However, adequate stock may not be able to arrest price rise fully as consumption or other use can't be stopped. For that reason, rather than nominal stock, stock-to-use ratio (SUR) is a better measure of the adequacy of stock. The authors suggest, by giving several examples, that low stocks of a grain is neither necessary nor sufficient for a price spike, so in order to understand grain price spikes, it is necessary to look at production and consumption disturbances together in the context of the current stock situation.

With available stocks data, which are agreeably imprecise, they conducted a test of whether SUR systematically relates to price behaviour in grain markets. It appeared that in sharp contrast to production, SUR appeared as a good indicator of vulnerability to shocks in all three grain markets as well as market for total calories supplied by the three grains. However, they highlight the fact that stocks are difficult to measure accurately. Changes in unreported stock holding of subsistence farmers, or of consumers can be important, but are not measured in available data. Public stocks are often managed in a way that reflects government objectives rather than market reality, and in many cases the size of public stocks is kept secret for strategic purposes. Large private corporations might also see strategic value in keeping the size of their own stocks confidential (p.20). These features of stocks imply that correlations between reported SURs and reported prices of grain will be far from perfect. But in spite of their inaccuracy, both price and stock, especially SUR, data together may be better indicators of the state of grain markets rather than price data alone.

Ott (2014) measured intra-annual (within crop year) and inter-annual (between crop years) price variability for wheat, maize, rice, barley, oats and rye and used a set of explanatory variables in a pooled regression to explain variations in these price volatilities. The results show that with low cereal stocks, supply (yield) shocks (defined here as volatilities, as for the price volatilities) mostly influence inter-annual volatility while other influential factors are the crude oil price and exchange rate. Cereal demand and interest rate shocks combined with low stocks affect intra-annual price volatility while other explanatory factors include exchange rate and crude oil price shocks. The derivatives market activity appears to have no significant effect on either intra-annual or inter-annual price volatility. In contrast, large cereal stocks and well-functioning international cereal market reduce the effects of shocks in the explanatory variables on both inter- and intra-annual volatilities.

Algieri (2014) investigated the drivers of wheat prices and quantified their impact by using a vector error correction model (VECM). The study was prompted by the fact that over the last decade, commodity prices have registered substantial booms and busts marked by extreme volatility. Wheat in particular, one of the main non-oil commodities, has registered a roller coaster in price levels which seems to be inconsistent with supply and demand fundamentals. In the model, the exogenous variables have been distinguished into four groups: market-specific factors, broad macroeconomic determinants, speculative components, and weather variables. It has been argued that the quadriangulation of the determinants enabled a better understanding of the movements in wheat price and identify the specific role of each component. The results show that a mix of factors are contributing to wheat price movements, including speculation, global demand, and real effective exchange rate.

Baffes and Haniotis (2016) analysed six agricultural commodities , and identified the relative weights of key quantifiable drivers of their prices. They conclude that increases in real income have negative effect on real agricultural prices, consistent with the Prebisch-Singer hypothesis and its predecessor Engel's law. Energy prices matter most (probably due to energy intensive nature of agriculture), followed by stock-to-use ratios and, to a lesser extent, exchange rate movements. The cost of capital affects prices only marginally, probably because it not only influences demand, but also evokes a supply response. They argue that when examined in tandem and against market fundamentals, the findings challenge the conclusions from unidimensional approaches that often put disproportionate weight on an individual factor.

Thus, it appears that researchers have used different perspectives and hypotheses to explain the problem of food price volatility. Studies that included food grain stock, especially stock-to-use-ratio, as a factor in the analytical model have shown this to be a key variable in explaining the nature and extent of price volatility. However, current data on stock at both global and national level are inadequate, of poor quality. In a review of the availability of food grain stock data and the methods applied to generate them, Abbott (2013) found that " while stocks are emphasized in market analysis, literature on how to estimate stocks is quite limited, and documentation of stocks estimation methodologies is brief and incomplete. Stocks estimates are often derived as a residual from food balance or supply utilization accounts, not survey data. Conflicting candidate residual variables and weak empirical foundations mean this method is likely to lead to poor estimates. Methods for resolving conflicts and the empirical foundations of this method are no better documented than are stocks surveys." (p.3).

Therefore, there is much to gain from investing in improving the methodology of stock data collection and the quality of collected data for better understanding the price volatility in food grain markets. Since Bangladesh is a minor net importer of food grains, domestic food grain market is intricately linked with global food grain markets. Price movements in the domestic market follow patterns in the global market, especially prices in some of the countries from where Bangladesh imports food grains (Hossain and Deb, 2010). Therefore, information on food stocks should be considered a key parameter in Bangladesh's food grain policy decisions, and investment in improving the quality of stock data will generate high payoff.

# 3 Review of Evidence on Private Stock of Food Grains in Bangladesh[2]

## 3.1 Changing food grain production, marketing and processing practices influencing private stocking pattern

The nature and extent of private stocking of food grains have undergone major changes over the last four decades due to three factors: changes in the relative importance of seasonal rice crops, emergence of wheat and then maize as minor grain crops, and changes in the processing technology.

Until the late 1960s, aman was the principal rice crop with aus a distant second while boro was a minor localized crop in some parts of the country. Typical on-farm storage period for aman rice for own consumption was up to eight months following harvest in November-December (Farruk, 1970). Where aus and/or boro was/were also important, the storage duration for each rice crop was shorter. Since the late 1960s, introduction of irrigated high yielding boro rice production led to changes in cropping pattern. The boro and aus seasons gradually became overlapped and irrigated boro replaced traditional aus in some places, and over time boro became a more important crop than aman pushing aus to the third position. Introduction of improved varieties in the aman season also contributed to the shift in the relative shares of the three rice crops (Table 1).

Table 1. Relative shares of seasonal rice crops in total rice output, selected years

| Year | Total production mmt | % share | | | Public procurement, % of output | |
|---|---|---|---|---|---|---|
| | | Boro | Aus | Aman | Boro | Aman |
| 1980-81 | 13.883 | 18.9 | 23.7 | 57.4 | na | na |
| 1990-91 | 17.785 | 35.7 | 12.7 | 51.5 | na | na |
| 1996-97 | 18.882 | 39.5 | 9.9 | 50.6 | 4.1 | 2.4 |
| 2000-01 | 25.085 | 47.5 | 7.6 | 44.8 | 4.5 | 2.2 |
| 2006-07 | 27.318 | 54.8 | 5.5 | 39.7 | 4.7 | 1.5 |
| 2010-11 | 33.541 | 55.5 | 6.7 | 37.8 | 2.4 | - |
| 2014-15 | 34.710 | 55.3 | 6.7 | 38.0 | na | na |

Source: BBS (2011, 2016).

Along with increased production, market participation and marketed surplus have also increased. Gross marketed surplus ratio for paddy increased from about 35% in the mid-1970s, to over 50% in more recent years (Jabbar, 2009; BIDS, 2012). The timing of sales also changed. Sales after harvest, especially in case of the largest crop boro, increased partly because of cash needs to pay for purchased inputs and repayment of

[2] Some aspects in this section are updates of a previous review, see (Jabbar, 2009), hence some repetition is to be expected.

credit, and partly because of inadequate on-farm storage capacity for the harvest coming towards the end of the summer and the beginning of the rainy season.

Wheat has been a minor food staple in Bangladesh compared to rice. In the early 1970s, domestic production of what was about 65,000 tons and 1.5 to 2 million tons used to be received as food aid. Production expanded rapidly since the mid-1970s due to availability of high yielding modern varieties and low cost subsidized irrigation. Production reached at its peak of about 1.84 million tons in 1999-2000. Jessore, Kushtia, Rajshahi, Faridpur and Comilla districts are major wheat growing areas. On the other hand wheat import as food aid declined over time but urban consumer demand for wheat and wheat based products increased so the private sector started importing wheat. In 2008-09, domestic production of wheat was about 0.85 million tons and private import was 1.8 million tons. Since then yearly production increased again reaching 1.3 million tons in 2013 and import stabilized at around 2 million tons (BBS, 2016, p.172).

In 1996-97, only 3,000 metric tons of maize was produced, which rose to 10,000 metric tons in 2000-01. Since then wheat has been gradually replaced by hybrid maize which turned out to be more suitable than wheat for the agro-ecological conditions of Bangladesh, was more profitable than wheat and also had a ready market as feed for the growing poultry industry. Since 2011, maize production surpassed wheat production reaching 1.5 and 2.7 million metric tons respectively in 2013 and 2014, and import has declined from 26, 000 tons in 2009 to 14,000 tons in 2013 (BBS, 2016, p.172).

Until the mid 1970s, home pounding with *dheki* accounted for 64-77% of paddy processing, small rural huller mills accounted for 17-30% and medium and large commercial rice mills accounted for 2-6% of rice processing in the country (Harris, 1979, quoting various sources). While rural huller mills provided custom processing services to farmers, so stocking paddy was not required for them, large and some medium commercial mills were primarily engaged in own processing business to serve urban rice markets which required procurement and stocking of paddy as well as rice. Some of these mills also provided custom processing services to the government to assist its food grain distribution function, which also required stocking for different durations. Most of the commercial rice mills were located in rice surplus districts of Dinajpur, Rajshahi and Bogra (Farruk, 1970).

Over time, with increased output and increased marketed surplus more or less throughout the country, a change in the rice processing technology has also occurred. Home pounding has virtually disappeared, large numbers of small huller mills serve custom processing needs in rural areas but the number of medium and large commercial mills has increased rapidly and they have become involved in rice processing business. Large size mills are mainly located in Dhaka, Chittagong, Rajshahi and Dinajpur. Small and medium sized mills have a more even distribution throughout the country. Licensed rice mills also play key role in the government procurement programme as government purchase rice from farmers as well as through or from millers.

During 1991-92 to 2011-12, yearly public procurement accounted for less than 5% of yearly boro output and less than 3% of amna output (Table 1). Of the yearly purchases of aman and boro rice, on average 21% was purchased directly from farmers and 79% from or through licensed rice millers. A general trend was that share of purchase from farmers gradually declined in both rice seasons. In some years, direct purchase of aman rice from farmers was zero or negligible (Alam et al., 2014). Therefore for millers licensed to sell to government procurement programme, a part of the stocking capacity is reserved for that purpose.

## 3.2 Empirical evidence on private stock of food grains in Bangladesh

Food grain marketing studies addressed questions of the extent of marketed surplus, extent of competition and efficiency in the market, the degree of market integration and informational inefficiency, and the role of pre-harvest credit on marketing behaviour of producers. With one or two exceptions, marketing studies virtually ignored the estimation of private grain storage or stock at a point in time at producer and trader levels, and how private and public stocks interacted to influence food grain market (Chowdhury, 1992).

Few studies that estimated private stock fall into two categories in terms of approach used. Some estimated aggregate national level stock using what may be termed as ‘residual approach’ while others estimated farmer and trader level stocks based on sample surveys, and some of them extrapolated sample estimates to arrive at national figures. A review of these is in order.

### 3.2.1 Residual approach to estimate aggregate stock of rice

Farruk (1970) provided an early estimate of month end aggregate private stock of rice by farmers and traders for the period 1959-60 to 1967-68. This is a dated study but is relevant for the methodology used. The study measured month end private stock as a residual of the difference between a putative consumption norm per person per month and monthly appearance of output from domestic production, i.e.,

Inventory at the end of month m = (opening stock at the beginning of the month
+ net harvest during the month)
– consumption during the month.

The estimates were made on the basis of the following assumptions:

- Aus harvest - 10% in June, 20% in July, 70% in August

- Aman harvest – 30% in November, 60% in December, 10% in January
- Boro harvest – 10% in March, 70% in April and 20% in May
- 89% of gross output was used for effective consumption, and 11% accounted for on-farm use as ‘feed, seed and waste’.
- Per capita consumption was 0.16 tons per year or 0.438 kg per day

Information on base population and yearly growth rate were not available in the report though it is obvious that some estimates were used. His estimated month end stocks showed negative figures for several months in most of the years. Chowdhury (1993) speculated that the estimated negative stocks in lean months might be equated with drawdown of rice stocks from public distribution system. However, Farruk also showed public sector share in monthly marketed rice elsewhere in his study but the estimated negative stocks did not appear to match those numbers.

Since November 2004, the Food Planning and Monitoring Unit (FPMU) under the Ministry of Food has been using an approach for estimating private stocks of rice, wheat and total combining rice and wheat for its internal decision making purposes. A working spreadsheet template is used to derive monthly closing stock, which is being treated as equivalent to total private stocks - farm and trader stocks combined. The equation is as follows :

$$S_t = (S_{t-1} + O_t - P_t + I_t + G_t) - C_t$$

where S = private stock at the end of a month t

O = share of harvest of a rice crop in the month

P = domestic procurement by the government during the month

I = private import during the month

G = government off take during the month[3]

C = domestic consumption during the month

t is any month during a year.

The estimates are based on the following parameters and key assumptions:

- BBS estimate for base population of and annual growth rates uniformly spread over 12 months are used.
- 16 ounces or 453.6 gms of rice and 17.25 ounces or 489 gms of total cereals consumption per capita per day to estimate aggregate domestic consumption of rice and cereals respectively.

[3] Perhaps what is implied here is public distribution during the month, in which case the term should be stated as such to convey the conceptually correct meaning.

- BBS estimate for annual rice production figures are used. Once BBS estimate for a rice crop is available, FPMU works out monthly distribution of the total estimated net output. Following assumptions have been made since November 2004 for monthly shares of harvest of the three rice crops :
  - Aman - November 10%, December 60%, January 30%
  - Boro - April 5%, May 40%, June 55%
  - Aus - July 25%, August 60%, September 15%
- Allowance for on-farm seed, feed and wastage: 2004-07 10% following BBS and from 2008 12% following a directive by the Ministry of Agriculture

The accuracy of the monthly stocks derived in this manner depends on the accuracy of the parameters and the assumptions made above as well as estimates on carryover stocks, domestic procurement and disposal. There is hardly any consensus on the accuracy of the available statistics on these parameters. Some of the problems will be highlighted later. Use of the template was apparently stopped since 2010.

### 3.2.2 Survey based estimates

Results of a number of detailed sample surveys on households and traders, and two rapid surveys are reviewed below.

#### 3.2.2.1 IFPRI survey 1989-90

After reviewing the literature on marketing and recognizing the gap in terms of estimation of private stocks of food grain, Chowdhury (1992) attempted to fill the gap arguing that 'virtually any worthwhile discourse on price policy begs the question on the level of private stocks'. He estimated private stock of rice, in addition to other aspects of rice marketing, based on a survey of farms and market agents by IFPRI in 1989-90. The farm sample distribution had a bias towards medium and larger holdings.

He stated that for a household the following identity should hold (when all quantities are derived from production alone):

$$I_t - I_{t+1} + Q_t = X_t + M_t$$

where Q is quantity harvested, M is quantity marketed, X is quantity consumed, $I_t$ is carry-in stock and $I_{t+1}$ is carry-out stock, and t is a seasonal subscript. Simply put, he assumed that 'what is neither consumed nor sold has to be stored across seasons or market periods'. So viewed the stored or stocked amount is represented by $I_{t+1}$ i.e,

$$I_t + Q_t - (X_t + M_t) = I_{t+1}$$

He further stated that "this accounting identity was implemented in quantity terms, which established a warrant for treating all rice/paddy receipts (whether purchases or received in public rationing or other food distribution schemes or in lieu of work performed) as additive. All estimates of farm stocks should be seen as relative to farm production, and net of purchases or transfers or kind-receipts" (Chowdhury, 1992, p.214).

Sample average estimates were blown up to get aggregate national level farm stocks under a set of assumptions. The estimated month end farm stocks for October 1989 to October 1990 are shown in Table 2 where trader and public stocks are also shown.

The key finding of this exercise with respect to private stocks have been stated as follows: "for the year as a whole private stocks amounted to 79% of total stocks" (p.223) implying that 21% was public stocks. Further, 'farm stocks account for 79% of private stocks during the aman season and some 78% during the boro season. (p.223). Thus farm stocks accounted for 62% of total stocks during the year and the remaining 17% lied with the traders. Monthly average private stocks amounted to an average of three months' rice consumption in the country as a whole, though only in October the ratio was lower than that and it was better in October 1990 compared to October 1989 due to a better harvest in 1990. The study found that compared to the 1960s, traders practiced quick turnover and shorter storage period in the early 1990s. Moreover, private stocks, especially farm stocks, played a bigger role in the determination of price, and public stocks displaced traders' stocks through non-farm stocks (Chowdhury 1992, 1993).

However, the estimated farm and trader level stocks still remained a bit fuzzy because of three main reasons. First, the numbers shown in Table 2 do not tally with the above narrative. Based on the figures in the table, private, trader and public stocks accounted for 85%, 23% and 15% of total stock of rice instead of respectively 79%, 17% and 21% mentioned in the text. The reasons for these apparent discrepancies are unclear. Second, the statement "all estimates of farm stocks should be seen as relative to farm production, and net of purchases or transfers or kind-receipts" did not clearly convey how in reality transactions like 'purchase, transfers and receipts' were treated within the equation. Like incomings, most likely there were outgoings in addition to sales, and it was not clear how those transactions were treated. Third, there was no clear explanation in the report on how monthly trader stocks were actually derived or estimated. There was no detailed information on monthly pattern of sales, purchases and other transactions by farmers and traders. The accuracy of the month end stock at both farmer and trader levels would very much depend on how these parameters were treated.

#### 3.2.2.2 FPMU rapid surveys in 1993 and 1994

In the early 1990s, after food market liberalization and larger involvement of private traders in rice imports, occasions arose when there were concerns about the socially desirable level of rice stocks in the country – private and public- due to variation in rice production, especially due to climatic reasons. In such circumstances, knowledge about detailed statistics on private –farm and non-farm- stocks of rice were necessary for proper management of the level of public stocks. In the absence of detailed survey based data, a series of three rapid rural appraisals (RRAs) were conducted in 1993 and 1994 by FPMU of the Ministry of Food for assessment of private stocks.

Table 2 Economy-wide end of month rice stocks (million metric tons), 1989-90

| Month | Farm stocks | Trader stocks | Total private stocks | Public stocks | Total stocks | Private stocks as multiple of rice consumption |
|---|---|---|---|---|---|---|
| October89 | 0.35 | 0.31 | 0.66 | 0.59 | 1.25 | 0.47 |
| November | 5.22 | 1.25 | 6.47 | 0.66 | 7.13 | 4.57 |
| December | 5.28 | 1.83 | 7.11 | 0.77 | 7.88 | 5.02 |
| January90 | 4.22 | 1.84 | 6.06 | 0.83 | 6.89 | 4.28 |
| February | 3.17 | 1.45 | 4.62 | 0.79 | 5.41 | 3.26 |
| March | 2.20 | 0.46 | 2.66 | 0.70 | 3.36 | 1.88 |
| April | 2.81 | 0.86 | 3.67 | 0.65 | 4.32 | 2.59 |
| May | 4.15 | 1.47 | 5.62 | 0.74 | 6.36 | 3.97 |
| June | 3.16 | 1.48 | 4.64 | 0.84 | 5.48 | 3.28 |
| July | 2.48 | 1.15 | 3.63 | 0.81 | 4.44 | 2.56 |
| August | 2.85 | 0.74 | 3.59 | 0.72 | 4.31 | 2.53 |
| September | 1.92 | 0.52 | 2.44 | 0.59 | 3.03 | 1.72 |
| October | 0.93 | 0.21 | 1.14 | 0.54 | 1.78 | 0.80 |
| Cumulative total | 38.74 | 13.57 | 52.31 | 9.23 | 61.64 | |
| Average/month | 2.98 | 1.04 | 4.02 | 0.71 | 4.74 | |
| % of total stocks | 62.9 | 21.9 | 84.8 | 15.2 | 100.0 | |

Note: Last three rows in the table are not shown in the original table in the report, they are worked out here to show inconsistency with the text as described below.

Source: Chowdhury (1992), p.221

The first one was conducted during October-December of 1993 to estimate stock levels in June 1992 and June 1993 based on a sample of 884 farms in 16 new districts and 412 millers in 13 of those 16 districts (Ahsan et al., 1994). The second RRA was apparently conducted during the first fortnight of January 1994 but its outcome was not available for review. The third one was conducted in June 1994 to assess stock level in mid June 1994 and compare that with the previous estimate for June 1993 based on a sample of 403 farms and 171 traders in 10 districts (Amin and Farid,1994).[4] The first and the third RRAs used similar approaches and stated that districts were classified into surplus and deficit ones and "as would be befitting for a stocks survey, districts generating rice surpluses were over sampled, as were medium and larger farms within each district". Similarly, millers were divided into those establishments who had a 'mill gate contract' and those that did not and samples were drawn separately. Average farm stock was blown up by corresponding weights (i.e., total number of farms nationally) to yield aggregate farm stocks. For millers and traders, average stocks for each type were blown up by their respective total numbers to get aggregate trader stocks.

The key findings of the first RRA were that (a) in the year to October 1993, private rice stocks at both farm and trader levels had declined compared to 1992, (b) the largest proportionate decrease occurred in case of the mills that had mill-gate purchase contracts in 1992, (c) between 1989/90 to 1992/93, the capacity of the rice markets to meet consumption demand had remained virtually unchanged. The key finding of the third RRA was that the farm stocks in mid June 1994 was about 5% lower than the previous June and trader stocks fell by 24% between the same periods. Overall private stocks fell by 10% in June 1994 compared to a year before. Both reports provided some explanation about the plausibility of their findings. The authors of the third report cautioned that their smaller sample size compared to the first RRA implied that much greater sample variance might be expected in their estimates.

Both the RRA reports showed not only the mid year levels of stocks, which were the stated objectives, but also estimated month end stocks for 13 months (October to October) for the reference year and compared those with the monthly stocks for 1989/90 reported by Chowdhury (1992). But in the RRA reports, the original 1989-90 figures (Table 2) were revised (Table 3) without giving any details of why and how those revisions were made.

However, the main concern about these RRAs is that the assertions about the accuracy of the key findings and results were not matched by the necessary degree of details of the methodology used in collecting data and deriving estimates. It may be noted that accurate estimation of monthly stocks would require data on population and its growth rate, production by season and its monthly distribution of harvest, consumption by month, marketed surplus by month, inventory changes etc.

[4] There are some differences in the stated size and distribution of samples in the two RRA reports. For details see Jabbar (2009).

### 3.2.2.3 BBS household income and expenditure survey 2010

The BBS conducts nationwide household income and expenditure surveys every five years to generate national parameters for monitoring economic progress and for planning purposes. The survey includes information on food production and disposal

Table 3 Economy-wide end of month rice stocks (million metric tons), 1989-90

| Month | Farm stocks | Trader stocks | Total private stocks | Public stocks | Total stocks | Private stocks as ratio of rice need |
|---|---|---|---|---|---|---|
| October89 | 0.86 | 0.50 | 1.36 | 0.58 | 1.94 | 0.96 |
| November | 5.73 | 1.44 | 7.17 | 0.60 | 7.77 | 5.10 |
| December | 5.79 | 2.02 | 7.81 | 0.72 | 8.53 | 5.54 |
| January90 | 4.73 | 2.04 | 6.77 | 0.82 | 7.59 | 4.80 |
| February | 3.68 | 1.64 | 5.32 | 0.84 | 6.16 | 3.77 |
| March | 2.71 | 0.66 | 3.37 | 0.75 | 4.12 | 2.39 |
| April | 3.32 | 1.06 | 4.38 | 0.64 | 5.02 | 3.11 |
| May | 4.66 | 1.66 | 6.32 | 0.65 | 6.97 | 4.48 |
| June | 3.67 | 1.68 | 5.35 | 0.82 | 6.17 | 3.79 |
| July | 2.99 | 1.34 | 4.33 | 0.85 | 5.18 | 3.07 |
| August | 3.36 | 0.94 | 4.30 | 0.83 | 5.13 | 3.05 |
| September | 2.43 | 0.72 | 3.15 | 0.78 | 3.93 | 2.23 |
| October | 1.44 | 0.40 | 1.84 | 0.65 | 2.49 | 1.76 |
| Cumulative total | 45.37 | 16.12 | 61.36 | 9.49 | 70.98 | |
| Average/month | 3.49 | 1.24 | 4.72 | 0.73 | 5.46 | 3.39 |
| % of total stocks | 63.9 | 22.7 | 86.6 | 13.4 | 100.0 | |

Note: Last three rows in the table are not shown by Chowdhury (1992) in the original report or in the RRA report by Ahsan et al. (1994), but they have been added here to show inconsistency with figures in table 2.

Source: Adapted from Chowdhury (1992) by Ahsan et al. (1994)

of rural households. Alam et al. (2014) analyzed the survey carried out during February 2010 – January 2011 to understand farmers' stocking behaviour with respect to rice. The sample in the HIES-2010 survey was selected using a two-stage stratified random sampling design technique. At the first stage, out of 1000 primary sampling units (PSUs) 612 were selected throughout the country from 16 different strata: 164 PSUs from 6 urban strata, 392 PSUs from 6 rural strata and 56 PSUs from 4 small metropolitan areas (SMA). At the second stage, 20 households were randomly selected from each of the selected PSU. Total sample size of the survey was 12,240 households: 7,840 households from rural areas and 4,400 from urban areas. Out of these households 4101 households were rice growers in the survey year. Out of the rice growers, 3245 households produced Boro, 2699 households produced Aman and 784 households produced Aus rice.

Estimated disposal of gross output including marketed surplus and end of season stocks are shown in Table 4. The authors have reported that HIES survey data did not include information on beginning stock, quantity purchased in the season, rent received from the tenants, any other in kind receipt. [5] Also monthly harvest, consumption, sales and purchase data were not recorded. Given these data limitations, marketed surplus and end of season stock estimates are probably underestimates. Moreover, since monthly data on incomings and disposal were not recorded, estimated end of season stock figures do not seem very useful.

#### 3.2.2.4 Survey on participants and non-participants in government procurement programme in 2012 boro season

Alam et al (2014) conducted a survey on stratified random samples of 181 participating and 305 non-participating farmers in 2012 boro season procurement programme in Mymnsingh, Tangail, Dinajpur and Naogaon districts. Estimated disposal pattern of gross output including marketed surplus and end of season stock of boro rice are shown in Table 5.

Like the HIES 2010 data, survey also did not include data on opening stock, rent received, purchase and other incomings, so the estimated disposal pattern does not seem to be realistic. For example, participants and non-participants had average output of 186 and 122 quintals of boro output per farm respectively. Yet both groups

[5] Wright (2009) in analyzing role of international grain reserves in addressing volatility in grain markets emphasized that in any period regardless of economic setting (monopoly, competition, oligopoly) two accounting relations hold: available supply for the period is the sum of the harvest and stocks carried in from the previous period, and consumption during the period is the difference between available supply and the stocks carried forward to the next period. Therefore, estimation of stocks without taking into account inventory changes, whether at individual household or at national or international level, is bound to be erroneous.

Table 4. Disposal of gross output of boro, aus and aman by farm size in Bangladesh, 2009-10

| | **Marginal farms** | **Small farms** | **Medium & large farms** | **All farms** |
|---|---|---|---|---|
| | % | % | % | % |
| **Boro** | | | | na |
| Consumption | 51.8 | 37.3 | 21.4 | |
| Sold | 20.1 | 34.4 | 52.8 | |
| Paid as rent to landlord | 11.8 | 9.8 | 5.7 | |
| Paid as wages in kind | 1.2 | 1.9 | 3.3 | |
| Seed | 0.7 | 0.8 | 0.7 | |
| Feed | 0.2 | 0.1 | 0.2 | |
| Wastage | 0.4 | 0.3 | 0.2 | |
| Other uses | 0.9 | 1.0 | 0.5 | |
| End of season stock | 12.8 | 14.2 | 15.2 | |
| **Aus** | | | | na |
| Consumption | 63.9 | 49.8 | 46.3 | |
| Sold | 13.7 | 28.4 | 33.5 | |
| Paid as rent to landlord | 8.3 | 11.1 | 6.2 | |
| Paid as wages in kind | 2.6 | 1.9 | 2.1 | |
| Seed | 2.1 | 2.1 | 2.0 | |
| Feed | 0.6 | 0.4 | 0.3 | |
| Wastage | 0.5 | 0.6 | 0.4 | |
| Other uses | 0.4 | 0.3 | 0.8 | |
| End of season stock | 7.7 | 5.3 | 8.2 | |
| **Aman** | | | | na |
| Consumed | 61.7 | 49.4 | 31.5 | |
| Sold | 18.5 | 28.5 | 43.6 | |
| Paid as rent to landlord | 11.3 | 10.5 | 7.5 | |
| Paid as wages in kind | 0.7 | 1.0 | 2.2 | |
| Seed | 1.0 | 1.5 | 1.6 | |
| Feed | 0.2 | 0.2 | 0.3 | |
| Wastage | 0.3 | 0.3 | 0.2 | |
| Other uses | 0.3 | 0.5 | 0.4 | |
| End of season stock | 6.0 | 8.0 | 12.6 | |
| **All rice*** | | | | |
| Consumed | 55.6 | 41.8 | 26.5 | 36.4 |
| sold | 19.2 | 32.2 | 48.4 | 39.2 |
| Paid as rent to landlord | 11.4 | 10.1 | 6.3 | 8.1 |
| Paid as wages in kind | 1.2 | 1.6 | 2.8 | 2.1 |
| Seed | 0.9 | 1.1 | 1.1 | 1.1 |
| Feed | 0.3 | 0.2 | 0.2 | 0.2 |
| Wastage | 0.4 | 0.3 | 0.2 | 0.3 |
| Other uses | 0.7 | 0.8 | 0.5 | 0.6 |
| End of season stock | 10.4 | 11.8 | 13.9 | 12.0 |

* Information on all farms for all rice has been derived from Baral (2016). The same source reported that for wheat, sales and end of season stock accounted for 52.1 and 12.5% of gross output and in case of maize, sales and end of season stock accounted for 93.6 and 0.5% of gross output.

Source: Calculated from Alam et al (2014) Table 4.1, p.31, Table 4.2, p.33. There are some estimation errors in the original tables.

consumed about the same proportion of output and participants sold 65% of output compared to 77% by non-participants. Moreover, shares of output disposed as seed, wastage and other uses are unusually low, which might have led to over estimation of the shares for consumption, sales and end of season stocks. Since details of what sources of wastage were considered, it is difficult to judge the validity of the wastage estimates. Figures for medium and large farms do not add up to 100. Overall the estimates have several conceptual/methodological problems and are highly suspect.

Table 5. Disposal pattern of gross output by participating and non-participating farmers in government procurement programme by farm size in four districts in 2012 boro season

| | Marginal +small farms | Medium and large farms | All farms |
|---|---|---|---|
| **Participants** | % gross output | % gross output | |
| Consumption | 14.9 | 7.3 | 7.4 |
| Sales | 62.1 | 84.8 | 64.6 |
| Donation | 1.2 | 1.0 | 1.0 |
| Seed | 1.1 | 1.2 | 1.0 |
| Post-harvest wastage | 0.9 | 0.5 | 0.5 |
| Other outgoings | 0.3 | 17.5 | 10.8 |
| End stock/storage | 19.6 | 14.7 | 14.7 |
| Total | 100.0 | **127.0?** | 100.0 |
| **Non-participants** | | | |
| Consumption | 10.1 | 6.7 | 8.4 |
| Sales | 79.1 | 80.8 | 77.3 |
| Donation | 0.7 | 0.5 | 0.7 |
| Seed | 0.6 | 1.0 | 0.8 |
| Post-harvest wastage | 0.6 | 0.7 | 0.6 |
| Other outgoings* | 3.6 | 0.4 | 2.0 |
| End stock/storage | 5.3 | 9.9 | 10.2 |
| Total | 100.0 | 100.0 | 100.0 |

*Includes poultry feeds, irrigation share, puffed rice, sale to BADC, share of paddy to land owner. For participants, components of other outgoings were not specified.

Source: Calculated from Alam et al (2014) Tables 5.26, p.63; 5.114 p.106. There are estimation errors in the original tables.

### 3.2.2.5 BIDS survey 2012

The FPMU of the Ministry of Food sponsored a study conducted by BIDS in 2012 on "estimation of the parameters needed for integrated and effective PFDS planning in Bangladesh" (BIDS, 2012). The primary objective of the study was to streamline the supply and demand side estimates of food and analyze the food gap in Bangladesh in view of the prevailing paradox of a food surplus (i.e., availability greater than consumption) on the one hand and significant food import on the other in recent years. Other objectives were to assist the government in early decision making in domestic and international procurement of food grain, and to determine the size of private stock, the size of the Public Food Distribution System (PFDS) and desirable public stocks of food grain over months.

The study generated its own estimate of population from 1996-2021, per capita food grain consumption, gross and net domestic production and supply, allowance for seed, feed and wastage, marketed surplus and private stocks, PFDS distribution, public stock and procurement needs, and finally food gap. Thus it is a more comprehensive study on food production, marketing and stocking compared to the other studies conducted on such issues in the past. These parameters have been derived on the basis of a two stage cluster survey conducted in March 2012 on samples of 2000 rural households, 500 urban households in 10 districts, and also 490 traders and millers of paddy/rice and wheat (including 80 paddy faria/aratdar, 80 rice aratdar, 50 each of rice wholesaler, rice retailer, wheat wholesaler, wheat retailer, 100 rice miller and 30 wheat miller). Data were collected for 2011.

In order to estimate private stocks of food grains, the BIDS study used a market chain approach and collected data on the flow of grains along the chain by looking at the selling behaviour of sample producers and all types of sample market actors to track sales of one actor to another, and derive retention or stock coefficient at a point in time from the difference between production/purchase and sales. Then the parameters derived from the sample farms and traders were extrapolated to estimate aggregate national stocks with producers and traders in 2011.

Some of the key parameters generated by the surveys that were used to determine the estimated stock levels are as follows:

- Projected population in 2011- 149.77 million (p.78) compared to BBS estimate of 144 million.
- Per capita daily consumption of cereals and rice respectively 509 gm and 463 gm compared to 442 and 416 gms found by the BBS in the Household Income and Expenditure Survey in 2010 (p.16).
- Monthly harvest share (p.87) –
    - Aus : 1% in Srabon, 97% in Bhadro, 2% in Ashwin
    - Aman: 20% in Kartik, 70% in Agrohayon, 10% in Poush
    - Boro : 51% in Baishakh, 46% in Jaistha, 3% in Ashar
- % gross output marketed by month:
    - Aus 23.3% in Bhadra, Aman 21 and 14% in Agrohayan and Poush, Boro 19 and 17% in Jaistha and Ashar
- Gross rice output in 2011: 31.15 million tons compared to BBS estimate of 33.54 million tons (p.131)
- Allowance for seed, feed, wastage – 12% (survey results showed the following rates : Aus 10.03%, Aman 12.83%, Boro 11.8%, all rice 11.6% ) compared to 10% used by BBS (p.70)
- % of gross output marketed : Aus 47, Aman 55, Boro 59, all rice 57% (p.91)
- % of net output marketed : Aus 53, Aman 63, Boro 65, all rice 64% (p.91)

- % of gross output of wheat marketed: 70.8% - 28%, 20%, 13% in Choitra, Baishakh and Jaistha respectively
- SFW ratio for wheat – farm level 13.3%, total 16.2%

Based on the above and other relevant parameters generated by the sample survey, estimated monthly national level stocks of rice and wheat at producer and trader levels in 2011 are shown in Table 6. The study claimed that due to overestimate of acreage and lower allowance for seed, feed and wastage, BBS estimate of rice production was about 5% higher than it should have been. Moreover, based on farmer reporting of area under rice, it appears that BBS estimate of acreage was also 2% higher than it should have been. Consumption rates used by BBS were also lower than what was found in the survey. Once these biases were corrected, the result led to 'debunking the puzzle in the food grains gap estimates' as there was a surplus of only 0.77 million tons in 2011 which was significantly smaller than the BBS and Ministry of Food estimates of 2-3 million tons. In 2009 and 2010 also estimated surplus was respectively 0.94 and 0.83 million tons and the level has been projected to remain between 0.60 and 0.36 million tons until 2016.

Overall, the methodology used in this study took into account some of the major pitfalls of the previous private sector stock estimates, so the figures apparently seem more reasonable. However, there still remain several methodological concerns that raise question about the accuracy of the estimates.

First, the survey included random sample of 2000 rural households and 500 urban households. No pre-stratification of the population or sample was done. But per capita consumption was estimated for rural vs urban and poor vs non-poor households. On the other hand, food grain production was estimated on the basis of 1600 farm households, implicitly implying 400 were non-farm households. Seed, feed and wastage and marketed surplus and stocks were estimated for the farm households by size of farm (small, medium, large) but not for poor vs non-poor households. So the study did not use a single consistent classification scheme to derive different key parameters yet used them for national level projections. How objective was the basis of projection in that case? Some specific questions are as follows.

- The proportion of rural vs urban sample was proportionate to national rural vs urban population estimated by BIDS but was the ratio same as BBS HIES sample? If not, the comparison of per capita consumption between the survey and HIES estimates was not fully realistic given the large differences found. So extrapolation on that basis might be questionable.

- The sample was divided into poor vs non-poor households based on HIES income levels. In urban areas this division was probably alright. In rural areas, a matrix of farm vs non-farm households and poor vs non-poor households would show that some farm households were poor and some non-farm households were non-poor. This classification is important because SFW, marketed surplus and stocks have been measured for farm households but consumption has been estimated with a different classification as shown

Table 6. Estimated month end stocks of rice and wheat at producer and trader levels in Bangladesh in 2011

| Month | Aus | Aman | Boro | All rice | Wheat |
|---|---|---|---|---|---|
| ***Stock with producers, 000 metric tons*** | | | | | |
| Baishakh | 60 | 300 | 6910 | 7270 | na |
| Joistha | 60 | 210 | 10670 | 10930 | na |
| Ashar | 50 | 160 | 7780 | 8000 | na |
| Srabon | 60 | 130 | 6800 | 6990 | na |
| Bhadro | 1180 | 110 | 6150 | 7440 | na |
| Ashin | 1010 | 100 | 5440 | 6560 | na |
| Kartik | 800 | 1120 | 4740 | 6660 | na |
| Agrohayon | 710 | 4650 | 4390 | 9740 | na |
| Poush | 640 | 3680 | 3940 | 8260 | na |
| Magh | 510 | 2560 | 3230 | 6310 | na |
| Falgun | 450 | 1620 | 2680 | 4750 | na |
| Choitra | 400 | 1010 | 2360 | 3780 | na |
| ***Stock with traders, 000 metric tons*** | | | | | |
| Baishakh | 0 | 61 | 1795 | 1856 | 578 |
| Joistha | 6 | 117 | 5666 | 5789 | 603 |
| Ashar | 0 | 193 | 5435 | 5629 | 629 |
| Srabon | 26 | 97 | 1263 | 1386 | 649 |
| Bhadro | 936 | 118 | 719 | 1773 | 674 |
| Aswin | 321 | 183 | 902 | 1406 | 677 |
| Kartik | 384 | 615 | 1170 | 2169 | 701 |
| Agrohayon | 93 | 4909 | 188 | 5189 | 702 |
| Poush | 36 | 3209 | 278 | 3523 | 713 |
| Magh | 177 | 1517 | 898 | 2592 | 734 |
| Falgun | 29 | 1228 | 576 | 1833 | 786 |
| Choitra | 0 | 616 | 38 | 654 | 1072 |
| ***Producers' stock as % of gross output*** | Aus | Aman | Boro | All rice | Wheat * |
| Baishakh | 2.9 | 2.4 | 37.1 | 20.8 | -21 |
| Joistha | 2.7 | 1.6 | 57.3 | 31.2 | -38 |
| Ashar | 2.5 | 1.3 | 41.8 | 22.8 | -46 |
| Srabon | 2.8 | 1.0 | 36.5 | 19.9 | -51 |
| Bhadro | 55.4 | 0.9 | 33.0 | 20.0 | -59 |
| Aswin | 47.6 | 0.8 | 29.2 | 17.7 | -64 |
| Kartik | 37.6 | 8.8 | 25.5 | 18.7 | -68 |
| Agrohayon | 33.2 | 36.3 | 23.5 | 29.5 | -71 |
| Poush | 30.1 | 28.8 | 21.2 | 24.8 | -75 |
| Magh | 24.0 | 20.1 | 17.4 | 18.8 | -80 |
| Falgun | 21.1 | 12.7 | 14.4 | 13.9 | -85 |
| Choitra | 18.9 | 7.9 | 12.7 | 10.9 | -34 |
| ***Traders' stock as % of gross output*** | | | | | |
| Baishakh | 0 | 0.5 | 9.6 | 5.0 | 59.5 |
| Joistha | 0.3 | 0.9 | 30.4 | 15.3 | 62.0 |
| Ashar | 0 | 1.5 | 29.2 | 15.1 | 64.7 |
| Srabon | 1.2 | 0.8 | 6.9 | 3.8 | 66.7 |
| Bhadro | 43.9 | 0.9 | 3.9 | 4.0 | 69.4 |
| Aswin | 15.0 | 1.4 | 4.8 | 3.6 | 69.6 |
| Kartik | 18.0 | 4.8 | 6.3 | 6.0 | 72.1 |
| Agrohayon | 4.4 | 38.4 | 1.0 | 19.2 | 72.3 |
| Poush | 1.7 | 25.1 | 1.5 | 12.8 | 73.4 |
| Magh | 8.3 | 11.9 | 4.8 | 8.3 | 75.5 |
| Falgun | 1.4 | 9.6 | 3.1 | 6.1 | 80.8 |
| Choitra | 0 | 4.8 | 0.2 | 2.4 | 110.3 |

* These are sample survey based figures Source: BIDS (2012)

above. Ideally production, consumption and marketed surplus and stock of rural households should have been done for farm vs nonfarm households or for consistency, the entire analysis should have been done for poor vs non-poor households. In that case, non-farm households - rich or poor – would have zero production, negative marketed surplus (net buyer) but stock could be positive due to purchase.

- Trader samples were not taken from the producer sample areas as well as other areas and inadequate numbers were taken from producer sample areas. Since grain flow map through the supply chain has been prepared by looking at sales by lower level actors to higher level actors in the chain, representative trader samples from production clusters would have generated more precise estimates of flows and the resulting coefficients.

Second, it is unclear how accounting and physical stock, and goods in transit for various trader types have been treated. Depending on whether spot purchase, pre-paid forward contract or post-paid forward contract or other forms of purchases have been made and whether paddy or rice has been purchased, there will be differences between accounting, physical stock and goods in transit. The implication is that the estimate for total stock in the trader chain, other things being accurate, may be ok but stock with a specific trader type may not be.

Third, though compared to other estimates of loss/wastage, a more detailed breakdown of the sources of loss/wastage has been done and data collected, a primary problem still remains. Each identified source of loss has been calculated as ratio of gross output, which is erroneous (see more on this later)

Fourth, private stock has been measured as per cent of gross or net production. This is meaningless and inaccurate because month end stock may be derived not only from the harvest or production during the month but from carry in stock in the beginning of the month as well as purchases or other incoming during the month. As mentioned earlier, for non-farm households, there is no production but stock can be positive due to purchase or other forms of receipts. Since overall stock ultimately depletes due to consumption and knowledge about stock is sought to determine if available stock is adequate to meet consumption needs, stock at various levels should be presented as a ratio of overall consumption needs or private plus public demand for the month. The sum total of the ratios is expected to be more than 1 and bigger is better.

Fifth, the claim about ‘debunking the puzzle in the food grains gap estimates’ appears over exaggerated. It has been claimed that BBS has overestimated output by about 7% which also led to larger estimate of stock compared to the stock estimate of this study. However, a closer look will reveal that the BIDS estimate of stock was low not because of overestimate of output by the BBS but because BIDS has failed to account for producer sales to non-farm households and stocks held by them. The study reported that sample producers sold 2, 8 and 5% of total sales (marketed surplus) of aus, aman and boro rice to non-farm households. In all 6% of all rice sold – about

0.93 million tons - went to non-farm households. Yet stocks were shown only at producer and trader levels disregarding those held by non-farm households. Since the objective of the study was to estimate private stock, stocks with both producer and non-producer households should have been estimated. Proper accounting of this missing portion would have shown that the 2011 surplus was at least 1.7 million tons, which was closer to the BBS estimate rather than the BIDS estimate of 0.77 million tons.

# 4 Quality of the Data and Options for Improvement

At a point in time, aggregate national private stock of any food grain is the sum total of stocks with all agents along the supply chain between producer households and consumers including non-producer rural and urban households, domestic private traders, processors and private importers of that food grain. Accurate estimate of aggregate private stock therefore depends on accurate information on the flow of the food grain along its supply chain.

Review of available information on estimation of food grain stock suggests that there is no systematic set up or infrastructure to collect stock data regularly. Few studies that estimated private stock fall into two categories in terms of approach used. The Ministry of Food used a 'residual approach' to estimate aggregate national level month end stock using a template and released the information in public domain for a few years. Though monthly stock data are still released as part of food price monitoring report, the method of calculation remains unclear as the former template is no longer used. Several stand-alone studies estimated farmer and trader level stocks at different points in time based on sample surveys on fairly small samples with limited geographic coverage. Among these, some of the relatively large studies extrapolated sample estimates to arrive at aggregate private stock with producers and traders. Only one such study used a supply chain approach and estimated stocks at different major points in the chain.

The accuracy of the economy-wide monthly stocks depends on the accuracy of the parameters and the assumptions made about gross and net production, population, per capita consumption as well as estimates on carryover stocks, domestic procurement and disposal. There is hardly any consensus on the accuracy of the available statistics on these parameters. The survey based studies are now dated so the stock figures as such are of no use. Moreover, all the survey based studies suffer from deficiencies in terms of sample frame, parameters used and methods applied for their generation. Some of the problems are highlighted below.

## 4.1 Estimation of domestic production and related issues

The BBS is the principal source of yearly area and production data though the Department of Agricultural Extension (DAE) contributes in the process of data generation. The SPARSO also estimates area for boro and aman. The provisional national food budget for a given fiscal year is prepared on the basis of DAE projection/target for each cereal crop. BBS's estimates are based on results of a large number of systematic crop cuts throughout the country in the beginning of the harvest season. DAE figures are ultimately reconciled with BBS estimates for actual/final production figures, as they become available, about six months after harvest (TAT-NFPCSP, 2008).[6]

The problem in using BBS estimates of output for monthly stock estimation is that final BBS estimates are available months after the data have been collected. So monthly stock estimation can't in reality be materialized on a current month basis with BBS data rather they have to be done with a significant degree of lag, which reduces the utility of the exercise.

A more fundamental problem with respect to production data is how it is defined or calculated. BBS released production data is expressed in terms of gross output in milled rice equivalent (see for example tables 4.31-4.34, p.141-43 in BBS, 2016). Then a deduction of 12% is made as allowance for seed, feed and wastage to get net output for disposal.[7] But the basis for the choice of 12% allowance is not clear.

Theoretically, either gross output or net output can be used as the base for showing pattern of disposal of national output into various forms including stock. In the former case, seed, feed and wastage are specific forms of disposal along with other forms such as consumption, sale and remaining stock at any time. In the latter case, shares of SFW in gross output are set aside to determine the volume available for consumption and other forms of disposal. The only implication is that because of the difference in bases, ratios of individual forms of disposal will be different under the two scenarios.

If estimation of disposal of net output is the chosen option, the question is what rate of allowance for SFW should be made at the national level and whether they should be bundled into one composite item or they should be treated separately. Determination of the rate of allowance for SFW has proved to be controversial because of large differences in estimates of SFW rates found in field studies (Table 7). However, figures in Table 7 are not directly comparable for a number of reasons.

First, some are aggregate figures without any breakdown of the components so it is difficult to guess what aspects have been included and which component accounts for how much. Some figures refer to only losses while others refer to seed, feed and wastage combined. Some refer to farm level losses while others refer to farm as well as trader and processor level losses, with or without detailed breakdown, while others refer to post-harvest losses due to processing and transportation. HIES data based estimates show unusually low rates of losses compared to the other survey results. The reason for this is unclear as detailed breakdown of sources of losses are not shown.

[6] BIDS compared area estimates of BBS, DAE, and other sources such as Census and found that in some cases the estimates are close while in other cases, there are significant differences due to differences in scope and methodology used (BIDS, 2012).

[7] Previously for calculating national level monthly private stocks of rice and wheat, FPMU initially made a 10% deduction for 'seed, feed and wastage' (SFW) but later, following a directive by the Ministry of Agriculture, a 12% deduction was applied. The same was done for preparation of the national food grain budget (TAT-NFPCSP, 2008).

Table 7 Summary of recent estimates for seed, feed and wastage in rice and wheat production

| Reference year | Data source | Domain of loss | Aus | Aman | Boro | All rice | Wheat/ maize |
|---|---|---|---|---|---|---|---|
| | UNICONSULT (1991) | SFW ( farm, milling, transport, handling) | | | | 12 | |
| | Calverley (1994) | Post harvest | | | | >13 | |
| | Quasem and Siddiquee (2009) | Post harvest | | | | >13 | |
| 2000 HIES | Murshid et al. (2008) | SFW(on-farm) | | | | 2.5 | 3.1 |
| 2005 HIES | Murshid et al. (2008) | SFW (on-farm) | 4.1 | 3.4 | 3.0 | 3.2 | 5.9 |
| 2007 | Murshid et al. (2008) | SFW (on-farm) | 8.2 | 6.2 | 4.2 | 5.0 | 10.2 |
| 2008-09? | Miah et al. (2010) | Farm level losses | 16.9 | 15.2 | 17.3 | 16.2 | |
| | | Seed | 2.5 | 1.9 | 1.2 | 1.6 | |
| | | Feed | 3.5 | 2.3 | 1.4 | 1.9 | |
| | | Total SFW | 19.0 | 16.1 | 16.9 | 17.0 | |
| 2008-09 | Bala et al. (2010) | Farm level losses | 10.2 | 9.2 | 10.1 | | 3.6/4.1 |
| | | Trader, processor | 1.5 | 1.7 | 1.8 | | |
| | | Total losses | 11.7 | 10.9 | 11.9 | | |
| 2011 | BIDS (2012) | Farm level losses | 4.0 | 10.1 | 10.4 | | 7.2 |
| | | Seed | 3.3 | 2.1 | 1.1 | | 5.7 |
| | | Feed | 0.01 | 0.1 | 0.1 | | 0.4 |
| | | Total farm level SFW | 7.3 | 12.3 | 11.6 | | 13.3 |
| | | Trader, processor | 3.8 | 2.9 | 2.9 | | 2.9 |
| | | Total SFW | 11.1 | 15.3 | 14.5 | | 16.2 |
| 2009/10 HIES | Alam et al. (2014) | On-farm losses | 0.5 | 1.4 | 0.3 | | |
| | | Seed | 2.0 | 1.3 | 0.7 | | |
| | | Feed | 0.4 | 0.2 | 0.2 | | |
| | | Total SFW | 2.9 | 2.9 | 1.2 | | |
| 2012 | Alam et al. (2014) | Farm level wastage | | | 0.5 | | |
| Procurement | | Seed | | | 1.0 | | |
| participants | | Feed and other uses | | | 10.8 | | |
| | | Total SFW | | | 12.3 | | |
| 2012 | Alam et al. (2014) | Farm level wastage | | | 0.6 | | |
| Procurement | | Seed | | | 0.8 | | |
| Non-participants | | Other uses | | | 2.0 | | |
| | | Total SFW | | | 3.4 | | |

Second, all the sources refer to loss/waste as a ratio of production, implicitly meaning gross output but it is unclear if gross output here means potential output of the standing crop in the field as defined by BBS. If gross output means actual output obtained after threshing, any loss or wastage occurring after threshing can be expressed as a ratio of harvested gross output but loss/wastage for pre-threshing stages of activities can't be expressed as a ratio of gross output because it is not possible to lose what is not there. Some pre-threshing losses/wastages may be inevitable because with available knowledge and technology, those losses/wastages may not be avoided. On the other hand some losses/wastages may be reduced, if not fully avoided, with existing knowledge and technology or with potential new technology and management. This latter category of loss/wastage is worth recording to enumerate form and extent of loss/wastage as a basis for investment to overcome the losses. But those losses/wastages should still be expressed as a ratio of initial potential output, not as a ratio of harvested gross output.

To illustrate the point, see the components of farm level losses considered in three recent major field surveys (Table 8). There are differences in the items considered, their definitions or nomenclatures, and the degree of disaggregation. Consequently some items have been missed altogether or some minor elements might have been missed in aggregated items. For example, some studies have shown stacking done before threshing potentially exposing to loss due to rodents and other reasons but others did not identify this source. Processing could be done before or after storage, i.e. storage could be in the form of paddy or rice with different rate of loss but this item is missing in some cases. Moreover, it is unclear what definition of output was considered and how it was measured or data were collected. These differences partly explain why the estimated rates of losses/wastages are so high.[8]

Information on losses/wastages beyond farm level with traders and processors are scarce. Among the recent studies, only BIDS (2012) reported both farm, trader and processor level losses. They found trader and processor level losses in aus, aman boro and wheat respectively as 3.8%, 2.9%, 2.9% and 2.9% of gross output (Table 7). An earlier micro study reported loss of 22% of gross output during processing and storage alone (Samajpati and Seikh, 1980) but it is unclear if that included trader and processor level losses. Moreover, the data reported in that study are now highly dated. In the preparation of the recent national food budget for 2009-13, wastage beyond the point of recorded production in processing, storage and transportation has been assumed as 5% in case of rice, wheat and maize though the basis of this assumption has not been mentioned (BBS, 2015, p.7).

Given the above scenarios with respect to available data on losses/wastages, it is questionable if a 10 or 12% or a higher rate of deduction is justified to get net output. The estimated rates of losses/wastages have implications for estimated private stocks. Higher rates of allowance for SFW means estimated private stocks as a residual will be lower by the same amount but the real private stocks will be higher than the estimated residual because the higher deduction rate for SFW means larger quantities are allowed to stay on-farm. For example, other things remaining the same, rather than 10%, a 12% allowance for SFW in 2010-11 would result in an extra 661, 000 metric tons of rice left with the farmers for disposal, which was about 80% of the total volume of domestic procurement of rice by the government in that year.

[8] An effort is underway to standardize procedures for estimating loss/wastage of agricultural commodities so that micro data can be aggregated at national, regional and global levels to understand the dimension of the problem of loss/wastage (http://www.wri.org/our-work/project/food-loss-waste-protocol). It is suggested that when losses at multiple stages of a production cycle or chain is to be calculated, loss at each stage in the cycle should be expressed as a ratio of initial potential output. So the cumulative total loss is equal to the sum total of loss on the potential output. Stage specific loss may be calculated as a ratio of stage specific net output which declines due to loss at previous stages. However, total loss can't be calculated as the sum total of stage specific losses as the bases for stage specific losses are different.

Table 8 Components or sources of farm level losses in rice production as shown in three major field surveys

| **BIDS (2012)** | **Bala et al (2010)** | **Miah et al (2010)** |
|---|---|---|
| Sample : 2000 farm households in 10 districts | Sample: 944 households in 16 upazilas in 8 districts | Sample : 1360 households in 96 villages in 26 upazilas in 14 districts |
| **Harvest Operations** | Harvesting | **Harvest loss** |
| Cutting | Transporting | Transportation loss |
| Field drying | Threshing | Threshing, winnowing, drying loss |
| Bundling | Parboiling | In-store loss |
| Delays in bringing field dried paddy to home yard | Drying | Others |
| Weather related factors | Storage | **Total post-harvest loss** |
| Birds, rodents, and insects | **Total losses** | **Total losses** |
| Others | | Seed |
| Total | | Feed |
| **Post-Harvest Operations** | | **Total SFW** |
| Transporting paddy from field to farm yard/threshing yard | | |
| Threshing, winnowing, cleaning and drying | | |
| Bulk handling for storage (bagging, sacking and biotic and abiotic) | | |
| Selling and out-store (de-storing, bagging, sacking, transporting and marketing) | | |
| Total | | |
| **Total farm level wastage** | | |
| Seed | | |
| Feed (Livestock, poultry, and pet animals) | | |
| **Total farm level SFW** | | |
| Total trader, processor level losses | | |
| **Total SFW** | | |

It is argued that some Asian countries use similar or even higher rates, e.g. for rice, Nepal and Pakistan use 10%, Sri Lanka uses 11.5%, Laos and Cambodia use 18%. India uses 12.5% for all cereals (TAT-NFPCSP, 2008). BIDS (2012) quoted other available estimates for Pakistan and India though it is unclear if these are officially used by the respective governments.[9] Miah et al (2010) summarized field based estimates of losses by FAO and several independent studies in a number of developing countries and several of those show rates of losses higher than 10%. However, BIDS and Miah et al did not review the methods used in various studies and the rationale behind such high estimates. The fact that other Asian countries use similar or higher rates on SFW account does not provide a strong logic for using similar rates in Bangladesh, especially because of the fuzzy method of estimation of rates of losses used in most field studies. A proper framework for estimating farm and trader level losses is required to generate accurate estimates for losses/wastages in order to get more reliable estimates for net output and private stocks.

Bundling seeds in SFW rate is also questionable because it implies a constant share for seeds in SFW allowance for each crop, which may not be realistic. Requirement of seeds depends on acreage to be planted next season and seed rate, which vary according to season/type of rice crop and variety. So there is a more straightforward way to measure seasonal or yearly seed needs and deduct that from gross output in so far as seeds produced by BADC and private companies are included in the estimated gross output. As an illustration, consider the aman season output in year t and seed needs in year t+1 (Table 9). It appears that at standard or recommended seed rates, only about 5.2-6.5% of year t local and broadcast aman output will be needed for planting the next season crops. For HYV aman, 1.2-1.4% of year t gross output and for aman as a whole, 2.5-3.0% of year t gross output will be required for planting the next season crops. These rates are close to farmer retention of seeds as a ratio of gross output found by Miah et al (2010), BIDS (2012) and Alam et al (2014).

Therefore, the assumption that a constant portion of output remains on-farm as seed, feed and wastage may not represent the reality on the ground. Higher allowance for SFW implies that in reality farmers are left with excess amounts for consumption or other form of disposal. So the estimated private stocks will be lower by the amount left with farmers in excess in the form of SFW.

Moreover, seeds are a tradable commodity. Many farmers no longer depend on own paddy seeds rather buy from market supplied by BADC, some private companies and other farmers (Table 10). Certain amount of seeds, e.g. hybrid seeds supplied by private companies, are imported. In case of maize, in recent years, over 80% of seed need has been met by import (Table 11).

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[9] Estimated seed, feed and wastage rates for rice and wheat in India and Pakistan

| **India** | Rice | Wheat |
|---|---|---|
| DGCIS and FCI | 12.5 | 12.5 |
| World Bank 1999 | 11-15 | 11-15 |
| 11th Plan Working Group | 7.6 | 12.5 |
| Kumar et.al. 2007 | 9.5 | 13.5 |
| **Pakistan** | | |
| Economic Advisor's Division | … | 10.0 |
| Ahmad 2009 | 17.1 | 15.3 |
| WFP 2003 | … | 12.5 |

Table 9. Hypothetical seed requirements in an aman season as a ratio of gross output of the previous season

| | Gross production in year t, 000 mt | Planned area in year t+1, 000 ha | Recommended seed rate, kg per ha* | Seed needs in year t+1, 000 mt | Seed need as % of gross production in year t |
|---|---|---|---|---|---|
| Aman broadcast | 458 | 500 | 50-60 | 25-30 | 5.4-6.5 |
| Aman Local | 2668 | 1730 | 80-100 | 138-173 | 5.2-6.5 |
| Aman HYV | 6693 | 3193 | 25-30 | 80-96 | 1.2-1.4 |
| Total | 9819 | 5423 | | 243-299 | 2.5-3.0 |

* Based on recommended seed rate per ha : broadcast aman 50-60Kg , Local aman 80-100 kg, HYV aman 25-30kg (Source : IRRI, Bangladesh Rice Knowledge Bank (BRKB), BBS & DAE). Also see, BBS (2016) Table 4.39, p148.

Table 10. Estimated paddy seed requirements and market shares of suppliers in 2007-08 crop year as reported by selected private companies

| Paddy type | Seed requirement, metric tons | % share of suppliers | | |
|---|---|---|---|---|
| | | BADC | Private companies | Farm households |
| Boro HYV | 116,750 | 55* | 25 | 20 |
| Boro hybrid | 10,500 | 1 | 99 | 0 |
| Aman local | 35,000 | 3 | 0 | 97 |
| Aman HYV | 93,500 | 40* | 10 | 50 |
| Aus local | 9,500 | 0 | 0 | 100 |
| Aus HYV | 19,350 | 25 | 0 | 75 |

* BADC claimed that it's share in that year was 39% for Boro HYV and 19% for Aman HYV, and private sector shares were higher by that amount.

Source: Jabbar (2011)

Table 11. Maize seed requirement in Bangladesh and supply sources, 2001/02 – 2009/10

| Year | Area, ha | Total seed need, mt | BADC, F*, mt | BADC, TLS*, mt | BRAC, mt | Import, mt | Import as % of total need |
|---|---|---|---|---|---|---|---|
| 2001-02 | 29900 | 538.20 | - | 161.0 | 357 | 236.1 | 44 |
| 2002-03 | 46000 | 828.00 | - | 162.0 | 324 | 196.3 | 24 |
| 2003-04 | 80000 | 1440.00 | 4.00 | 155.0 | 402 | 386.2 | 27 |
| 2004-05 | 104180 | 1875.24 | 4.89 | 221.0 | 600 | 2113.5 | 113 |
| 2005-06 | 137177 | 2469.19 | 12.50 | 214.0 | 868 | 3885.0 | 157 |
| 2006-07 | 208845 | 3759.21 | - | 155.0 | 1050 | 3134.8 | 83 |
| 2007-08 | 382000 | 6876.00 | 12.25 | 53.0 | 900 | 4507.7 | 66 |
| 2008-09 | 174000 | 3132.00 | - | 40.17 | 816 | 5400.9 | 172 |
| 2009-10 | 202000 | 3636.00 | - | 131.0 | 600 | 3115.4 | 86 |
| *F= Foundation Seed, **TLS= Truthfully Labeled Seed | | | | | | | |

Source: DAE, BRAC and BADC quoted in (GMark, 2013)

Adequate supply of high quality seeds is the foundation for a science based high productive agriculture, so it is important to ensure adequate supply of seeds by various suppliers. For that reason, for all cereal crops, it is advisable to keep seed retention by farm households as well as commercial suppliers separate and explicit rather than bundling with loss and wastage. Showing seeds as a separate form of disposal like consumption will give more realistic estimate of private stocks.

On the other hand, use of good quality rice or wheat as feed may be rare but some low quality output considered as unsuitable for human consumption hence wastage may in fact be used as feed. Hence keeping wastage and feed use together may not be unrealistic in case of rice and wheat under current situation in the country. Industrial use of grain is a form of disposal of net output down the line, hence need not be considered for estimating net output itself.

## 4.2 Monthly harvest pattern

There is no agreed data on pattern of distribution of harvest of each crop over months. For example, BBS mentioned the following harvesting times for different rice crops without showing shares of harvest by month (BBS, 2016, Table 4.39, p. 148):

- Aus Mid July- August
- Broadcast aman Mid November – Mid December
- Transplanted aman December – January
- Local boro April-May
- HYV boro Mid April- June
- Wheat March – mid April

FPMU used the following ratios perhaps on the basis of DAE guidelines/projections:

- Aman - November 10%, December 60%, January 30%
- Boro - April 5%, May 40%, June 55%
- Aus - July 25%, August 60%, September 15%

BIDS used the following ratios based on their survey in 2012:

- o Aman: 20% in Kartik, 70% in Agrohayon, 10% in Poush
- o Boro : 51% in Baishakh, 46% in Jaistha, 3% in Ashar
- o Aus : 1% in Srabon, 97% in Bhadro, 2% in Ashin

Since English and Bengali calendar months do not fully match one to one, the two sets of figures are not directly comparable. However, it appears that even after conversion to similar calendar months, the ratios will differ between the two sets that show monthly harvest shares.

Crop calendars may change by a few days or by one or two weeks due to many reasons – short or long duration variety, early or late rain, flood situation, availability of seeds or fertilizers etc. resulting in variable planting and harvest times. Though a standard harvest pattern may be used as a base, quick surveys may be conducted to validate its relevance in a given year.

## 4.3 Marketed surplus and monthly sales pattern

Marketed surplus and its distribution over months and destinations of marketed output are yet another set of key ingredients for accurate estimation of monthly private stocks. From available statistics on marketed surplus, it can be concluded that the ratio has increased substantially reaching over 50% of gross output in recent years (Table 12). But actual magnitude still remains unclear. There are some differences in the definition of gross marketed surplus used in the studies quoted in the table (for details on studies published before 2010, see Jabbar, 2009). So the ratios are not always directly comparable but they provide an order of magnitude to get a rough approximation.

Moreover, monthly harvest pattern has implication for monthly sales pattern and stocks. For example, Bayes and Hossain (2007) have shown that in 2003-04, 42% of total sales of paddy occurred within the first month of harvest, in case of small farms it was 65%. They did not report the calendar months of sales. BIDS survey 2012 showed that farmers conducted 23.3% of aus sales in Bhadra, 21 and 14% of aman sales in *Agrohayan* and *Poush* respectively, and 19 and 17% of boro sales in J*aistha* and *Ashar* respectively.

Thus, monthly harvest and sales patterns may vary between years, which need to be recognized in estimating national level monthly stocks.

Table 12. Estimated gross marketed surplus of rice (% of gross production) for selected years, 1976- 2012

| Reference year | Source of data | Boro rice | Aus rice | Aman rice | All rice |
|---|---|---|---|---|---|
| 1976/77-78/79 | In Dey, 1988* | | | | 34 |
| 1977 | Quasem 1979 | | | 30-40 | |
| 1979/80- 81/82 | In Dey, 1988* | | | | 36 |
| 1982 | In Dey, 1988* | 43 | 24 | 18 | 28 |
| 1982/83-84/85 | In Dey, 1988* | | | | 39 |
| 1982/83 | Islam et al , 1987 | | | | 25 |
| 1982/83 | Akter, 1989 | | | | 23 |
| 1986/87 | In Dey, 1988* | | | | 42 |
| 1986/87 | Murshed & Rahman,1988 | | | | 26-36 |
| 1989/90 | Chowdhury, 1992 | 64 | 64 | 34 | 49 |
| 2001/02 | Alam and Afruz, 2002 | 58 | 38 | 48 | na |
| 2003/04 | Bayes & Hossain, 2007 | | | | 41 |
| 2010 | Baral, 2016 | | | | 39 |
| 2011 | BIDS, 2012 | 59 | 47 | 55 | 57 |
| 2012 | Alam et al., 2014 | 65 | | | |
| 2012 | Alam et al., 2014 | 77 | | | |

* For original data sources for these, see Dey (1988)

### 4.4 Population

FPMU used BBS estimate of population and annual growth rate uniformly distributed over 12 months. BIDS in its 2012 study made its own projection about population and growth rate. For example, in 2007-08, BBS estimate of population was 146 million compared to National Food Budget data base estimate of 143 million and UNDP estimate of 156 million and (TAT-NFPCSP, 2008; Jansen and Fernando, 2008). For 2011, BBS, BIDS and World Bank estimates were respectively 144 million, 149.8 million, 153.4 million, and UNDP estimate was even higher. Large differences in population estimates have several implications for estimation of stocks at all levels. Even a difference of one million population means annual rice consumption estimate at per capita daily consumption rate of say 453.6 gm is off by 166, 000 metric tons.

It is generally advisable to use BBS estimates as this is the recognized official estimate for planning and all other forms of official use in the country. However, when BBS population figures are used for intercensal years, the implications of other estimates need to be kept in view for sensitivity of the estimated stocks.

### 4.5 Daily consumption rate

The FPMU in its template for national level stock estimation used 16 ounces or 453.6 gms of rice and 17.25 ounces or 489 gms of cereals consumption per capita per day to estimate aggregate domestic consumption of rice and cereals respectively. The Household Income and Expenditure Survey 2005 by BBS showed per capita per day consumption of 469.2 gms of cereals of which rice accounted for 439.6 gms (BBS, 2007, p.45). But in the 2010 survey BBS found per capita consumption of 416 and 442gms of rice and cereals respectively. The national food budget for 2009-13 has been prepared using the HIES 2010 consumption rates. The BIDS survey in 2012 showed per capita daily consumption of rice and cereals respectively as 463 and 509 gms, which they used for national level stock estimation.

There are other figures for cereal and rice consumption rates in the country. A working paper on national food budget preparation has shown scenarios of food budget on the assumption of the nationally recommended cereal consumption of 486.2 gm/day, FAO recommended rate of 496.6 gm/day, and nutritionally desirable cereal consumption rate of 405 gms/day. All these are also constant rates for a given year and they are normative rates which may or may not be achieved in reality.

There are also evidences of seasonal variation especially in the rural areas. For example, a baseline survey for a technology dissemination project for smallholder poverty alleviation conducted by IRRI and three NGOs- CARE, Practical Action and Action Aid - on 2181 poor and marginal households spread over several districts found that 60% of the sample households reduced quantity of food grain consumption in the month of *Kartick* due to shortage in food supply, about 50% did so in *Aswin* and *Choitra*, about 30% did do in *Baishakh* and *Falgun*, 24% in *Bhadra*, 13-16% in *Aashar* and *Shrabon* and the lowest 9% did so in *Jaistha* and *Poush* (IRRI, 2007).

Another survey conducted at the end of the project to assess its impact also found that in times of lean months and in periods following natural disasters like flood or loss of crops due to other reasons, households with inadequate food supply and income to purchase adequate food, reduced daily consumption is used as one of the strategies to cope with the situation (Jabbar et al., 2010).

Thus, per capita consumption appears to vary over time, by season and by source of data. A difference of 1 gm per capita per day consumption at a point in time can change the estimated private stock by a significant volume. For example, for a population of 145 million, 1 gm consumption difference per day will mean a difference of 4350 tons of grain for a 30 day month.

BBS conducts HIES every five years and sample design apparently takes care of seasonal variation in consumption. So HIES based estimates may be good for stock calculation for the survey year but application of a constant daily rate of consumption for years until a new set of estimate is available is likely to distort actual consumption and estimated stocks for the months and years. On the other hand, smaller sample survey based estimates may be also unreliable because of smaller size of the samples and location specificity of the surveys.

Given that HIES is conducted nationally on a large sample, most recent HIES based consumption data may be used as the base, then for subsequent years the base figure may be calibrated/updated by using latest available survey data from various sources until a new set of HIES data are available. Even though by regulation, BBS is the mandated authority to conduct national level surveys on key issues, use of research based findings to calibrate/update BBS data will only enhance its value and credibility. Interaction between BBS and the research community is in the best interest of all stakeholders.

### 4.6 Distribution of private stock along the supply chain

In addition to aggregate private stock, there may be interest in information on the extent of stocks lying at different points in the supply chain. If knowledge about producer vs trader stocks is adequate for handling policy decisions, generation of robust data may not be too difficult. However, if more disaggregated information on stock at each point in the chain is required, generation of data may be complicated because of the large number of smallholder producers and multiplicity of traders of different types involved in the chain. Moreover, no standard or generally agreed typology of traders with agreed definition of each type is available. For example, while studying rice market structure and performance, Chowdhury (1992) identified *faria, paiker, bepari,* wholesaler/*aratdar, and* millers *who* were involved in paddy marketing; and millers, *crusher, kutials, paikers,* wholesaler/*aratdar,* and retailer were involved in rice marketing. Siddique (2010) found *faria, bepari, paiker, aratdar*, wholesaler and retailer engaged in rice marketing. BIDS (2012) sampled rice miller, paddy *faria/aratdar*, rice *aratdar*, rice wholesaler, rice retailer, wheat wholesaler, wheat miller and flour retailer. Raha et al (2013) in their study on rice market integration sampled *faria, bepari, aratdar* cum wholesaler, *aratdar a*nd miller in case of paddy, and *aratdar c*um wholesaler, wholesaler, wholesaler cum retailer, retailer and importer in case of milled rice. GMark (2013) studied maize value chains in the char areas in five upazilas in four northern districts and found *Forias* (middle-men), small traders, wholesalers and contractors as common intermediaries between maize growers and poultry and fish feed industries who buy about 80% of output, about 1% is consumed directly by producers and the rest goes to various food manufacturing industries for use as food ingredient. In the above studies, definition of some trader types varies to some extent. Therefore, any attempt to generate data on stock with specific trader type should start with preparation of a standard typology of traders with clear definition of each type.

In the BIDS survey, a market chain approach was used to record data on the flow of grains along the chain by looking at the selling behaviour of sample producers and all types of sample market actors to track sales of one actor to another, and then retention or stock coefficient was derived at a point in time from the difference between production/purchase and sales. Then the parameters derived from the sample farms and traders were extrapolated to estimate aggregate national stocks with producers and traders. Results show that sample farmers sold 97, 78 and 81% of respectively aus, aman and boro sales to farias and local traders/aratders and the rest to other farmers and millers. Farias in turn sold to commission agents and millers (BIDS, 2012). Though the study did not show the storage period, if any, by farias, the very nature of their business imply that they resold at the quickest possible time, so storage time may be mostly zero or very minimal for sales to millers. The study did not include industrial processors, restaurants and hospitality institutions to complete the chain. Industrial processing of rice into food products is perhaps minimal though significant portion of wheat and maize are respectively processed into food and feed.

While this is an appropriate approach, its implementation for routine use is quite complicated. Once a typology of traders is agreed upon, clarity is required on how accounting and physical stock, and goods in transit for various trader types should be treated. Depending on whether spot purchase, pre-paid forward contract or post-paid forward contract or other forms of purchases are used by traders in the domestic market and whether paddy or rice is traded, there will be differences between accounting stock, physical stock and goods in transit. The implication is that, other things being accurate, the estimate for total stock in the supply chain may be accurate but stock with a specific type of agent in the chain may not be.

Given this scenario, one pragmatic approach may be to distinguish between traders without storage facilities who simply buy and sell to make quick margin, and traders with storage facilities who stock for temporal arbitrage or speculative margin. There may be sub-categories in the latter group, e.g. trade in paddy or rice or both, with or without milling facility. For purposes of estimation of stock at a point in time, primary traders without storage facility may be grouped together and assumed to have zero stock, implying that sales by farmers instantly pass through primary traders to traders having storage facility. Then develop realistic grain flow map for both domestically produced and imported grains and derive retention or stock coefficient at a point in time for farmers and principal trader types with storage facilities. Extending the chain to food industry is also advisable at least to determine how much grains flow into them. What happens after that may or may not be pursued as restaurants and hospitality institutions usually have quick turnover – they buy frequently and use up rather than store for longer periods.

# 5 Summary and Recommendations

Price volatility in the global food grain markets triggered studies to understand the underlying reasons, especially of the price spike in 2007-08. Researchers have used different perspectives and hypotheses to explain the problem and studies that included food grain stock, especially stock-to-use-ratio, as a factor in the analytical model have shown this to be a key variable in explaining the nature and extent of price volatility. However, current data on stock at both global and national levels are inadequate, of poor quality and there is much to gain from investing in improving its quality for better understanding the price volatility in food grain markets and for take more appropriate policy decisions.

In this study, past efforts in the collection and dissemination of food grain stock data in Bangladesh and their conceptual and methodological strengths and weaknesses have been reviewed with a view to identify data gaps, methodological deficiencies and suggest measures required for improvement of mechanism of data collection and quality of data. Major problems in the mechanism for stock data collection and quality of data are summarized along with recommendations to overcome them.

**Data collection mechanism**

The review revealed that currently there is no mechanism for regular collection and dissemination of food grain stock data in spite of its usefulness in the formulation of food policy and monitoring food grain markets and prices. A template previously used by the Food Policy Monitoring Unit at the Ministry of Food for estimation of month end aggregate private and public stocks is no longer in use. However, FPMU still releases monthly public stocks of food grains as part of monthly monitoring report on food grain production, disposal and prices but the methodology for stock estimation is not published.

The only other source of macro-level stock data is the Household Income and Expenditure (HIES) survey conducted by the Bangladesh Bureau of Statistics (BBS) on a nationwide sample every four or five years. This detailed survey includes information on food grain production and disposal including end of season stocks for different rice crops, wheat and maize. However, the surveys conducted in the past missed information on carry-over or carry-in stocks between seasons or periods and also some other aspects of disposal. The survey covers only households, no traders or other agents in the supply chain are covered. BBS generally releases meta-data or average statistics at national and district levels on major parameters of interest for assessing income, expenditure and demand systems as well as other socio-economic indicators. BBS does not undertake detailed analysis of the data on stocks and does not release any information on a regular basis. The incompleteness of the data combined with long gap in conducting the survey reduces its usefulness for food policy and market monitoring purposes.

Various stand-alone surveys conducted in the past at different points in time focused mainly at the producer level as part of grain marketing studies, some covered specific trader type but rarely all agents in the supply chain from households through domestic private traders, processors and private importers of the grain to consumers. Such studies also had several conceptual and methodological deficiencies. Being sporadic with small sample size and geographical coverage, these survey results have location specificity, hence are not always suitable for extrapolation to the national level.

The accuracy of the economy-wide monthly stocks depends on the accuracy of the parameters and the assumptions made about gross and net production, marketed surplus and sales pattern by month, population, per capita consumption as well as estimates on carryover stocks, domestic procurement and disposal. There is hardly any consensus on the accuracy of the available statistics on these parameters either from nationwide or from sample surveys.

After reviewing food grain stock data collection status in a number of developed and developing countries, Abott recommended "the desirability of estimating stocks utilizing both commercial and on-farm surveys, conducted separately on an annual or seasonal (quarterly) basis. This information is needed to complement existing public stocks information that is often the only information currently available. The goal is to capture carry-out stocks from one crop year (season) to the next. It is useful to measure public, commercial and on-farm stocks, and to report stocks positions in each of these categories. Surveys with limited scope, rather than comprehensive rural household surveys, are required to insure a focus on accurate stocks data collection." Further, he made more detailed recommendations on a menu of options on what to measure, when and how often to measure, identification of relevant agents for surveys, collection methods and logistics, sample strategy and design, questionnaires to be used, documentation and reporting of results (Abbott, 2013, p.3).

**Recommendation 1 :** It is critical to determine the nature of demand or end user requirement of any stock data to guide the purpose and scope of any elaborate stock data collection effort. Once this is done, the institutional responsibility for data collection and dissemination should also be determined. Specific roles of the BBS, the Ministry of Food (especially FPMU), the Ministry of Agriculture (especially DAE and Department of Agricultural Marketing) and any other relevant agency should be agreed upon. Any supply drive project based data collection may serve as a pilot and it is desirable to incorporate experience of such pilot in national institutional mechanism for data collection.

Operational issues pertaining to conceptual framework, frequency and methodology of data collection and dissemination will follow from the above. The general guide suggested by Abbott may be used as a starting point and choose and adapt relevant elements and options to meet specific objectives and needs of food grain stock data collection in the country. Suggestions on a few specific surveys are mentioned below to address problems of quality of specific parameters.

### Production estimates

BBS is the official data source for official analyses, therefore it should be taken as the data source for estimation of private stocks. The main problem is that BBS data become available months later after processing of crop cut results, so BBS data is not available for current monthly estimation of private stock.

In order to calculate net output available for disposal, BBS previously made a deduction of 10% from gross output as allowance for seed, feed and wastage, which has been recently revised to 12%. Empirical studies show wide variation in SFW rates ranging from below 5% to over 20%. But in these studies, there are problems of definition of loss/wastage and how it has been calculated. Studies differ in terms of the sources of loss/wastage being considered as some considered the whole range from cutting to processing while others considered only some sub-sets, and it is unclear in most cases whether loss/wastage has been calculated as a ratio of potential gross output as done by BBS or actual harvested gross output. In reality, loss/wastage should be calculated as a ratio of potential output rather than gross harvested output. Estimate for pre-threshing loss/wastage out of potential output may help, in addition to stock calculation, identify technology options to minimize them and to design crop insurance schemes.

Moreover, bundling seeds, feed and wastage together seem inappropriate because seed rate vary between crops ranging from about 1.5% of gross output in case of HYVs and 5-7% in case of local varieties, and a significant portion of the seeds are sourced from the market. Therefore a more than justified rate of allowance for bundled SFW results in under estimation of stock with farm households.

**Recommendation 2:** Make provisional estimate of production based on DAE projection of acreage and output, and revise as necessary once BBS data based on crop cutting become available.

**Recommendation 3:** Allowance for seeds should be separated from feed and wastage so that crop-specific seed rates can be applied to estimate allowance for seeds, thereby avoid over estimating allowance for SFW and under estimate household level stock,

**Marketed surplus and monthly harvest pattern**

Over time, both production and marketed surplus have increased. Both planting and harvesting of a particular crop is spread over several weeks and the actual calendar dates may vary slightly from year to year due to climatic and other reasons. Moreover, because of ecological differences, there may be spatial differences in the planting and harvest schedules. However, up to date estimates of marketed surplus and monthly harvest pattern are not available.

Large nationwide survey for collection of marketed surplus and sales pattern data is costly, time consuming and of no real value for continuous monthly stock monitoring as the results of such large survey may not be available for months. Hence conducting such survey regularly for this purpose is impractical and may be of no real value.

**Recommendation 4:** Given the paucity of up to date nationwide data on monthly harvest pattern and marketed surplus as a vital parameter, a detailed focused baseline marketing survey may be conducted in each of three rice seasons and also for wheat and maize to provide a robust initial estimate. Then a pragmatic approach may be to put in place an institutional mechanism led by the DAE and the Department of Agricultural Marketing to regularly conduct seasonal quick surveys or RRAs throughout the country to generate marketed surplus and monthly harvest pattern data for each grain crop to feed into an agreed mechanism for monthly stock calculation.

**Recommendation 5:** HIES is conducted every few years mainly with a view to generate aggregate data on production, consumption, income and savings. Since information on output, sales and purchases are essential for accurate estimate of consumption and income, it is essential that a full household accounting approach is applied to generate data. This will require inclusion of information on opening and carry over stocks, all incomings and outgoings during a year, losses and wastages and closing stocks. However, HIES is already data-heavy, so too much detail on stock related data should be avoided so that information fatigue does not adversely affect the quality of the overall survey.

**Producer vs trader stock**

In addition to aggregate private stock, there may be interest in information on the extent of stocks lying at different points in the supply chain. If knowledge about producer vs trader stocks is adequate for handling policy decisions, generation of robust data may not be too difficult. However, if more disaggregated information on stock at each point in the chain is required, generation of data may be complicated because of the large number of smallholder producers and multiplicity of traders of different types involved in the chain. Moreover, no standard or generally agreed typology of traders with agreed definition of each type is available.

**Recommendation 6:** A pragmatic approach to handle the lack of data on trader typology and stock with various trader types, may be to distinguish between traders without storage facilities who simply buy and sell to make quick margin, and traders with storage facilities who stock for temporal arbitrage. There may be sub-categories in the latter group, e.g. trade in paddy or rice or both, with or without milling facility. For purposes of estimation of stock at a point in time, primary traders without storage facility may be grouped together and assumed to have zero stock, implying that sales by farmers instantly pass through primary traders to traders having storage facility. Then develop realistic grain flow map for both domestically produced and imported grains and derive retention or stock coefficient at a point in time for producers and principal trader types with storage facilities.

Information on grain flow along the supply chain should be combined with the baseline survey on marketed surplus estimation, and also with follow up quick surveys or RRAs.

**Recommendation 7:** Survey on food industry, restaurants and hospitality institutions should be optional and be guided by specific needs. Given the high cost of covering multiplicity of these agents, the marginal value of the information should be weighed against the marginal cost of data collection.

## Aggregate consumption

Population and per capita daily consumption rates are necessary for this parameter. Population estimates vary between sources but BBS is the official source for all official analysis. Therefore, BBS estimate of population should be consistently used in order to avoid controversy around choice of one or the other source.

On per capita consumption, BBS's periodic Household Income and Expenditure survey based consumption estimates are derived from large nationwide sample, so the data for the survey year may be the best among various sources. However, HIES is conducted every five years and significant changes in consumption rate and pattern may occur during inter-survey years. Hence estimated monthly stock may vary widely depending on the rate of per capita daily consumption assumed.

**Recommendation 8:** Given that HIES is conducted nationally on a large sample, most recent HIES based consumption data may be used as the base, then for subsequent years the base figure may be calibrated/updated by using latest available survey based research data generated by various national and international institutions until a new set of HIES data are available.

## BBS mandate and collaboration with others

By regulation, BBS is the mandated authority to conduct national level surveys on key issues and BBS conducts periodic or one time surveys on various issues as required. Other ministries and public bodies may also conduct national level surveys on specific issues of relevance to their work areas with prior approval and agreement with BBS. This in already being done, for example, fisheries and livestock related surveys are conducted by the relevant Ministry and Departments. However, most of these surveys by BBS and other ministries/departments generate basically statistics but not much detailed analysis. So the full value of these surveys is not realized. Sometimes such survey data is made accessible to researchers for in depth analysis, which enhances the usefulness of the surveys.

Outside national level surveys conducted by BBS and other ministries/departments, universities, research institutions and international agencies operating in the country also conduct many surveys and studies of various sizes and scope spending public funds. Such studies are conducted on specific issues for academic purposes as well as to provide evidence for public policy making. Because of limited geographic coverage and smaller size of samples compared to BBS and other national level surveys, results of academic studies may have location specificity, hence may not always by suitable for extrapolation to national level. Such survey results are not usually recognized or used by BBS as they are conducted without prior approval of BBS. In reality such approval is neither pragmatically possible nor necessary as universities and research institutions are also mandated to conduct public funded research, so lack of prior approval should not be a constraint in their use as long as they are conducted scientifically.

**Recommendation 9:** More interaction and collaboration between BBS, other data generating ministries/departments and the research community is desirable to make better use of large data resources of these agencies through in depth analysis. Moreover, since large BBS surveys like HIES surveys are conducted after every few years, BBS may sponsor and use survey based research findings by national and international institutions to calibrate/update BBS data to enhance their values until new HIES are conducted. More interaction between BBS and the research community and division of labour based on agreed guidelines and principles will be in the best interest of all stakeholders.

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