

PN-ACP-994

**GRADES, STANDARDS AND INSPECTION  
PROCEDURES OF RICE IN BANGLADESH**

**A.K.M. NURUL AFSAR \***  
**MOHAMMAD BAQUI\*\***  
**MAHFOOZUR RAHMAN\*\*\***  
**M.ABDUR ROUF\*\*\*\***

**FEBRUARY 2001**

*FMRSP Working Paper No. 20*

**FMRSP** Bangladesh

*Food Management & Research Support Project*

Ministry of Food, Government of the People's Republic of Bangladesh

**International Food Policy Research Institute**

*This work was funded by the United States Agency for International Development (USAID)*

*Contract Number: 388-C-00-97-00028-00*

---

*The views expressed in this report are those of the authors and do not necessarily reflect the official position of the Government of Bangladesh or USAID.*

A

# **GRADES, STANDARDS AND INSPECTION PROCEDURES OF RICE IN BANGLADESH**

**A. K. M. NURUL AFSAR \***  
**MOHAMMAD BAQUI\*\***  
**MAHFOOZUR RAHMAN\*\*\***  
**M. ABDUR ROUF\*\*\*\***

**FEBRUARY 2001**

*FMRSP Working Paper No. 28*

**FMRSP Bangladesh**

*Food Management & Research Support Project*

*Ministry of Food, Government of the People's Republic of Bangladesh*

**International Food Policy Research Institute**

*This work was funded by the United States Agency for International Development (USAID)*

*Contract Number: 388-C-00-97-00028-00*

---

\* Director General, (Food), MOF

\*\* Chief Agricultural Engineer, BARI

\*\*\* Researcher, FMRSP

\*\*\*\* Director Training, DG(F), MOF

B

## ACKNOWLEDGEMENTS

The authors would like to thank all the officers and staff of the Directorate General Food, the Ministry of Food, and the Government of Bangladesh for their wholehearted assistance and co-operation in conducting this study. Thanks are due to the Officers in Charge of the Central and Local Storage Depots at various locations in the country for providing us the samples of stored government rice. We also thank the numerous millers and traders of the country who also provided us with rice samples and shared with us the benefits of their life-long experience in these matters.

We thank the laboratory staff of the Bangladesh Rice Research Institute, who analyzed the rice samples and helped us in every manner possible.

There are so many people from many professions and trades who co-operated and helped the authors with the study, too many to mention by name here, but all their help and assistance are gratefully acknowledged. The limitations, errors and omissions that remain in these papers are the authors' own and do not reflect on these experts and practitioners.

## TABLE OF CONTENTS

ACKNOWLEDGEMENTS .....	i
LIST OF TABLES AND FIGURES.....	v
LIST OF APPENDICES AND THEIR TABLES.....	vi
EXECUTIVE SUMMARY .....	ix
<b>1. INTRODUCTION .....</b>	<b>1</b>
BACKGROUND .....	1
OBJECTIVES OF THE STUDY.....	2
EXPECTED OUTPUTS .....	2
METHODOLOGY .....	3
<b>2. AN OVERVIEW OF RICE GRADING, INSPECTION AND MARKETING IN THE SELECTED ASIAN COUNTRIES AND THE USA. ....</b>	<b>4</b>
BANGLADESH .....	4
INDIA .....	5
NEPAL .....	9
MYANMAR (BURMA).....	10
<i>Burma Paddy</i> .....	10
<i>Burma Rice</i> .....	11
PAKISTAN.....	12
<i>Inspection and Grading at Procurement Centres</i> .....	13
<i>Sampling and analysis</i> .....	13
<i>Weighment</i> .....	13
<i>Super Check on Quality</i> .....	14
CHINA.....	14
<i>The Grading of Rice</i> .....	15
<i>Rice Marketing and Pricing</i> .....	16
JAPAN .....	17
<i>Method of Inspection</i> .....	17
<i>Inspection Standards</i> .....	18
THAILAND.....	18
MALAYSIA .....	20
<i>Milled-Rice Grading</i> .....	21
INDONESIA.....	22
VIETNAM.....	23
PHILIPPINES.....	24
USA .....	25
<b>3. COMPARABLE CRITERIA OF RICE GRADING IN ASIA AND USA.....</b>	<b>26</b>

DEFINITIONS OF SOME TERMINOLOGIES USED IN THE RICE STANDARDS OF SOME COUNTRIES.....	26
COMPARISON TABLE OF PHILIPPINES RICE SPECIFICATIONS AGAINST, THAI, VIETNAM AND PAKISTAN .....	30
COMPARISON TABLE OF BANGLADESH RICE SPECIFICATIONS AGAINST INDIA, NEPAL AND PAKISTAN .....	31
<b>4. QUALITY ASSESSMENT OF MILLED RICE IN BANGLADESH.....</b>	<b>32</b>
VARIETY .....	32
CLASSIFICATION OF BANGLADESH RICE ACCORDING TO GROWING SEASON.....	32
<i>Aus</i> .....	32
<i>Transplanted Aman</i> .....	33
<i>Boro rice</i> .....	33
<i>Aromatic</i> .....	33
QUALITY CHARACTERISTICS OF RICE.....	34
PHYSICAL QUALITY .....	37
MILLING QUALITY.....	38
<b>5. AN OVERVIEW OF THE RICE MILLING INDUSTRY IN BANGLADESH.....</b>	<b>39</b>
PROCESSING OF RICE.....	40
MILLING CAPACITY .....	40
CONSTRAINTS OF THE EXISTING RICE MILLING SYSTEM.....	40
SUGGESTED IMPROVEMENT OF MILLING SYSTEM.....	41
<b>6. FINDINGS FROM THE FIELD SURVEY .....</b>	<b>42</b>
COARSE VARIETY .....	47
MEDIUM VARIETY .....	47
FINE VARIETY .....	48
AROMATIC VARIETY .....	48
<b>7. PROPOSED CLASSIFICATION OF MILLED RICE FOR DGF BASED ON ITS BREADTH.....</b>	<b>50</b>
PROPOSED GRADE OF PARBOILED COARSE MILLED RICE FOR INTERIM DGF PROCUREMENT.....	50
<b>8. STORAGE AND INSPECTION PROCEDURES.....</b>	<b>53</b>
INSPECTION DURING PROCUREMENT.....	53
SAMPLE ANALYSIS.....	54
PRESENT DGF STORAGE AND DISPOSAL INDICATORS.....	55
PROPOSED STORAGE AND DISPOSAL INDICATORS .....	55
DETERMINATION OF PERCENTAGE INSECT DAMAGE GRAIN.....	55

DETERMINATION OF PERCENTAGE WEIGHT LOSS USING TGM METHOD .....	56
<b>9. IMPLEMENTATION PROCEDURES.....</b>	<b>57</b>
PRESENT SINGLE GRADE PROCUREMENT SYSTEM AND ITS LIMITATIONS.....	57
PARTICIPATORY IMPLEMENTATION PROCEDURE OF GRADES AND STANDARDS .....	58
<b>10. TRAINING.....</b>	<b>61</b>
TRAINING NEEDS FOR LABORATORY PERSONNEL AND INSPECTORS ...	61
LABORATORY PROCEDURE FOR MILLED RICE ANALYSIS .....	61
GENERAL OVERVIEW OF LABORATORY PROCEDURE .....	62
DETERMINATION OF HEAD RICE/ BROKENS/BREWERS .....	64
<i>Preparation of Working Samples</i> .....	64
<i>Head Rice/Brokens/Brewers Determination</i> .....	64
<i>Determination of Paddy Content, Foreign Matter and Chalky/Mature/ Damaged/ Discolored/Red-streaked/Red kernels</i> .....	67
DETERMINATION OF THOUSAND GRAIN MASS (TGM).....	70
GRAIN APPEARANCE .....	70
DETERMINATION OF MOISTURE CONTENT .....	71
DETERMINATION OF MILLING DEGREE USING THE STAINING METHOD .....	72
DETERMINATION OF PERCENTAGE OF INSECT DAMAGED GRAIN.....	74
DETERMINATION OF PERCENTAGE OF WEIGHT LOSS USING TGM METHOD .....	74
<b>11. STRENGTHENING PHYSICAL FACILITIES FOR DGF LABORATORY... 75</b>	<b>75</b>
LIST OF LABORATORY EQUIPMENT .....	75
<b>12. STRENGTHENING PHYSICAL FACILITIES FOR DGF LIBRARY .....</b>	<b>77</b>
LIST OF BOOKS .....	77
<b>13. CONCLUSIONS.....</b>	<b>78</b>
<b>14. RECOMMENDATIONS, STRATEGY AND POLICY IMPLICATIONS.....</b>	<b>79</b>
<b>REFERENCES.....</b>	<b>80</b>
<b>APPENDICES.....</b>	<b>82</b>

## LIST OF TABLES AND FIGURES

Table 1 — Physical Properties of Some Modern and Local Rice Varieties .....	35
Table 2 — Protein Content, Amylose Content and Cooking Properties of Some Modern and Local Rice Varieties .....	36
Table 3 — Rice Processing in Bangladesh .....	39
Table 4 — Quality Analysis of Milled Rice Samples (Aman, Parboiled Coarse) Collected from Selected LSD's DGF .....	43
Table 5 — Quality Analysis of Milled Rice Samples (Boro, Parboiled Coarse) Collected from Selected LSD's DGF .....	44
Table 6 — Quality Analysis of Milled Rice Samples Collected from Selected Rice Mills of Bangladesh (Parboiled-Coarse).....	45
Table 7 — Quality of Milled Rice Samples (Parboiled-Medium) Collected from Rice Mills .....	45
Table 8 — Quality of Milled Rice Samples (Un-parboiled-Fine) Collected from Rice Mills .....	46
Table 9 — Quality of Milled Rice Samples (Un-Parboiled-Aromatic) Collected from Rice Mills.....	46
Table 10 — Proposed Grades for Parboiled (Coarse) Milled Rice .....	51
Table 11 — Proposed Grades of Milled Rice for Future DGF Procurement (Boro).....	51
Table 12 — Proposed Grades of Milled Rice for Future DGF Procurement (Aman).....	52
Table 13 — Quality Standards for Milled Rice .....	62
Figure 1 — Flow Chart for Milled Rice Analysis .....	63
Figure 2 — Classification of Milled Rice.....	65
Figure 3 — Classification of Grain Moisture Measurement Methods .....	71
Table 14 — Standard Specifications for Milled Rice.....	74

## LIST OF APPENDICES AND THEIR TABLES

Appendix 2.1.1 — Milled Rice Production in Bangladesh (1995-2000) .....	82
Appendix 2.1.2 — Bangladesh Pure Food Rule, 1967 .....	83
Appendix 2.1.3 — Bangladesh Standard Specification for Grades on Milled Rice (First Revision, BDS 592 : 1981, BSTI).....	85
Appendix Table 2.1.4 — White Rice.....	88
Appendix Table 2.1.5 — Parboiled Rice.....	88
Appendix 2.2.1 — Standard Specifications for Milled Rice of India (National Grade) ...	92
Appendix Table 4a — Specifications for Rice – Fair-Average Quality of India (1972)...	92
Appendix Table 2.2.2 — Schedule of Specifications for Rice, India, 1997-98 .....	94
Appendix 2.3.1 — Quality Standards of Nepalese Rice.....	95
Appendix Table 2.3.2 — Parboiled Rice.....	96
Appendix 2.4 — Standard Specifications for Milled Rice of Burma (Myanmar).....	97
Appendix 2.4.1 — Types of Burmese Rice .....	97
III. Appendix Table 2.4.1.1 — Specifications of Burmese (Myanmar) White Rice .....	99
IV. Appendix Table 2.4.1.2 — Specifications of Burmese (Myanmar) Loonzain Rice.	100
Appendix 2.5 — Standard Specifications for Milled Rice of Pakistan .....	102
Appendix Table 2.5.1 — Specifications of Basmati White and Parboiled (Pakistan) ....	102
Appendix Table 2.5.2 — Specifications of Special Quality Basmati.....	102
Appendix Table 2.5.3 — Specifications of Irri-6 (a) and Irri-6 Arcsiled (S.I.A.).....	103
Appendix 2.6 — Standard Specifications for Milled Rice of China. ....	104
Appendix 2.6.1 — Explanation of Chinese Milled Rice Specifications.....	104
Appendix Table 2.6.2 — Early Xian Rice and Xian Glutinous Rice .....	105
Appendix Table 2.6.3 — Late Xian Rice .....	106
Appendix Table 2.6.4 — Early Geng Rice .....	107
Appendix Table 2.6.5 — Late Geng Rice and Geng Glutinous Rice.....	108



Appendix 2.7 — Standard Specifications for Milled Rice of Japan.....	109
Appendix Table 2.7.1 — Quality Standards for Fully Milled Rice.....	109
Appendix 2.8.1 — Standard Specifications for Milled Rice of Thailand (BE 2541, AD 1998).....	114
Appendix Table 2.8.2 — Section 7 Standards for Parboiled Rice (Thailand).....	125
Appendix 2.9 — Standard Specifications for Milled Rice of Malaysia .....	126
Appendix Table 2.9.1 — Grade of Rice (Malaysia).....	126
Appendix Table 2.9.2 — Specifications and Grading Requirements of the Grades of Rice .....	127
Appendix 2.10 — Standard Specifications for Milled Rice of Indonesia .....	130
Appendix Table 2.10.1 — Quantitative Specifications (Indonesia).....	130
Appendix 2.11 — Standard Specifications for Milled Rice of Vietnam .....	130
Appendix 2.12 — Standard Specifications for Milled Rice of Philippines.....	134
Appendix Table 2.12.1 — Quality Standards for Milled Rice Philippines .....	134
Appendix 2.12.2 — Some Useful Definitions .....	135
Appendix 2.13 — Standard Specifications for Milled Rice of USA.....	137
Appendix 2.13.1 — Grades and Grade Requirements for the Classes Long Grain Milled Rice, Medium Grain Milled Rice, Short Grain Milled Rice and Mixed Milled Rice .....	141
Appendix 2.13.2 — Grades and Grade Requirements for the Class Second Head Milled Rice.....	142
Appendix 2.13.3 — Grades and Grade Requirements for the Class Screening Milled Rice .....	143
Appendix 2.13.4 — Grades and Grade Requirements for the Class Brewers Milled Rice .....	144
Appendix 3.0 — The Physical Properties of Aromatic and Fine Varieties of Rice in Bangladesh .....	145
Appendix Table 3.1 — Quality of Aromatic Milled Brown Rice from Indian Automatic Rice Mills .....	145
Appendix Table 3.2 — Quality of Aromatic Brown/milled Rice from Chinese Automatic Rice Mills .....	146

Appendix Table 3.3 — Quality of Aromatic Milled Rice from Engleberg Huller Mills.....	148
Appendix Table 3.4 — Milling Yields from Aromatic Paddy .....	149
Appendix Table 3.5 — Samples of Rice Obtained from Automatic and Chinese Mills During Fieldwork.....	149
Appendix Table 3.6 — Grain Size and Shape of Specialty Rices .....	150
Appendix Table 5 — Survey Questionnaire .....	151
Appendix Table 5.1 — Flow Diagram of Rice Processing .....	153

## EXECUTIVE SUMMARY

The major objectives of this study are:

- To review existing Directorate General Food (DGF), Ministry of Food, and Government of Bangladesh internally procured grades of rice
- To review the existing grades of the Asian region, particularly of Thailand, Pakistan, and India and also those of the USA
- To devise modern standard grades
- To recommend ways to implement procedures to ensure standards and grades of rice in the domestic, as well as international, export and import markets

### GRADES AND STANDARDS IN SELECTED COUNTRIES

The existing DGF procurement grade was reviewed. The study was carried out by literature review, field surveys, personal interviews with concerned persons, and analysis of collected samples. A comparative study on the grades and quality of rice was carried out using the data from the survey, the existing grades of the DGF, and information regarding other neighbouring rice producing countries including the USA.

In all, grades and standards of 13 countries, including Bangladesh, were reviewed and major findings were noted and described in the paper.

Countries under review more or less followed similar grading parameters for rice grading. These are: moisture content, head rice, broken (big and small), damaged kernel, discoloured/yellow kernel, chalky, immature grain, foreign matter, red kernel, admixture of other varieties and degree of milling. Among them, moisture content, brokens and impurities in the grain are the major factors influencing grading specifications regarding the quality of the product. Moisture content of milled rice was 14% for all the countries except Nepal. The percentage of big broken in non-parboiled (white-milled) rice of the comparable grades of the Philippines, Gr. 1 and Gr. 2, Thailand 15% broken and 25% brokens, Vietnam 15% broken & 25% broken, Pakistan Gr. 3 & Gr. 4, India Gr. A and Gr. common, and Nepal Grade 3 and Gr. 4 were 19.75% & 34.50%, 17% & 28%, 16% & 27%, 15-20% & 20-25%, 24% & 30%, 25-30% & 15% & 25%, respectively.

The percentage of brokens in parboiled rice of comparable grades of India, Nepal, Pakistan and Bangladesh are 15% and 17%, 16-20%, 12.5-15% and 10-12%, respectively. Major impurities in percentage, including discoloured grain and chalky kernels, for the Philippines, Thailand, Vietnam, Pakistan, India, Nepal and Bangladesh were (2-4, 5-10), (1, 7), (1, 7-8), (nil, 8-10), (8 & 6), (4-8, 7-8), and (1-1.5, nil) respectively.

Comparable criteria of rice grading of most rice-producing countries in Asia including Bangladesh are quite similar. However, in the USA, quite a different set of parameters of grading is utilised.

Quality standards for milled rice depend on a number of factors. Some of those are variety, season of cultivation, physical impurities, climate, milling methods, and cooking methods, etc.

#### CLASSIFICATION OF RICE

Rice has been classified by the FAO based on its size and shape, namely, slender, medium, bold (coarse) and round, according to the milled kernels' length/breadth ratio. The length-breadth ratio of slender, medium, bold (coarse) and round grain are more than 3, 2.4 to 3.0, 2.0-2.39 and less than 2.0 respectively.

Rice processing is the biggest food industry in Bangladesh, with about 100,400 large and small rice mills. Two different types of marketing and milling systems are found in the country. The small huller type mills at rural areas process about 16 metric tons of paddy per week. Large huller and rubber roll mills process about 30 metric tons of paddy per week per unit. Fully automatic rice mills with modern parboiling (CFTRI, India) units process about 200 metric tons per week. Over 90% of the rice in Bangladesh is parboiled before milling. In terms of milling capacity, this is adequate for the country, but the quality of milling needs to be improved through introducing/incorporating a two stage milling system and ancillary processing equipment. This improvement in milling technology will reduce milling losses to a great extent, and will provide the nation additional milled rice out-turns compared to the same quantities of paddy currently being

processed by inefficient mills. In addition, by improving the quality of rice to conform to international standards, it will create opportunities for exporting quality rice in the international market.

### FIELD SURVEY ON RICE GRADE AND QUALITY

A field survey was conducted at 7 LSDs of 4 districts and 8 rice mills of 8 districts in order to collect information relevant to rice quality, grading, storage and marketing. Rice samples were collected from the government storage units and from private rice mills. These samples were analysed in the laboratory using a standard methodology. Quality parameters including moisture content, brokens, and other impurities were determined. Moisture contents of both LSDs and rice mill samples were below 14% on the average. The big broken percentage for coarse (Boro and Aman), fine and aromatic rice on an average were 2.55% and 2.44%, 3.88% and 7.77%, respectively. These analyses indicate that the broken percentage is higher in fine and aromatic varieties than in coarse varieties of milled rice in Bangladesh. Therefore, a maximum of 5% big broken may be suggested for coarse rice grading instead of 8%. Although, the results from the DGF samples indicate a higher percentage of small broken (5.79%) compared to the existing limit of 3%; however, the percentage of small broken from the mills was about 3%. It is thus suggested that the allowable limit of small brokens may remain the same as before (3%). Total brokens in Boro rice was higher (8.03%) than in Aman rice (6.1%). Total brokens in aromatic milled rice is higher in Bangladesh (15.9%) compared to those of Pakistan (12.5%). Other quality parameters including chalky and immature grain, damaged and dead grain, admixture of other varieties, paddy, foreign matters and red kernels were found to be at levels below the present DGF standard.

### SUGGESTED CLASSIFICATION OF MILLED RICE

Considering literature reviews, personal interviews, and survey results of rice sampled from government procured stocks and from rice mills, the milled rice of

Bangladesh should be classified into four groups—coarse, medium, fine, and aromatic—for consideration and eventual adoption.

Classification of rice varieties based on its size and shape is universal. The majority of Bangladesh rice varieties are bold/coarse having their length of kernels below 6.00 mm. The breadth of different rice varieties is distinctly different from each other. In general observation, breadth and/or thickness provide the observer the types of grain, e.g. coarse, medium and fine (Tables 1 and 2). The particular aroma of the variety provides the class of aromatic variety. Generally, the aromatic varieties have a slender kernel. The coarse group includes varieties whose breadth is more than 2.00 mm. The medium group includes varieties whose breadth ranges from 1.70 to 2.00 mm. The fine group includes varieties whose breadth is less than 1.70 mm. The aromatic group is considered separately as a special group that includes varieties that intrinsically possess aroma. The breadth of kernels of these varieties generally ranges from 1.55 to 1.74 mm.

The existing single grade for procurement by the DGF may be continued with some improvement in the quality parameters. This single DGF grade, after some modifications, is proposed for the interim period, until such time multiple grades are adopted.

### IMPLEMENTATION

In addition to existing DGF inspection procedures, the following procedures are suggested for improvement in grades and standards of government procurement:

- Before procurement, concerned technical personnel of the DGF should visit and inspect rice lots tendered by the authorized dealers/millers.
- Upon inspection of the commodity, the inspector should record the date of inspection, grade and other necessary information on the lot.
- In sampling, a standard method must be followed.
- Scientific analysis should be carried out for all samples.
- The TGM method should be used to determine weight loss of stored commodities at a definite interval. It is suggested that the first such test be carried out after 6 months of storage, and subsequently, every 2 months.

- To find an alternative to the existing storage and disposal indicators, the following techniques and procedures may be used after testing at a properly equipped laboratory. These procedures, in short, are:
  - Determination of percentage of insect damage grains
  - Determination of percentage weight loss using the TGM method

Suggested grade standards for DGF procurement may be implemented in phases.

These suggested steps should be:

- Undertake a pilot program to develop new grade testing methods and apply this technique in LSDs and procurement centres to test its efficiency.
- A working group of experts should identify and record practical problems and suggest solutions.
- DGF procurement staff should be trained on the application of new grading techniques for procurement after its development.
- After the pilot program phase, these procedures may be gradually introduced nationwide.

#### TRAINING, LABORATORY AND LIBRARY

Training needs on procurement and storage management of DGF personnel were clearly reflected in the survey. Training related to overall management of LSDs, laboratory techniques, procurement, grading, inspection, storage and quality control might be arranged for the DGF personnel at different levels to update knowledge and skill. Such training is a continuous process and may be conducted on a regular basis.

Existing laboratory equipment at the DGF is not adequate to perform all the tests. Therefore, modern equipment should be procured and installed. A list of such equipment is included in these papers.

At present, there is no librarian for the DGF library, which is mostly stocked with local books. To upgrade the library to the standard level, relevant books and journals on food grain inspection, storage and management should be procured. A list of such books is also included in these papers.

## CONCLUSIONS

In sum, classification, grades and standards of rice are of vital interest to the nation. It is imperative to introduce modern grades and standards for a multiple of reasons. They are important to the consumers, as cereal grains supply a large percentage of dietary calories for the people of Bangladesh. The government also procures large quantities of food grains from the internal market. Thus, it is a prerequisite that appropriate grades of food grains are procured so that they are fit for long storage and a wholesome and nutritious product is supplied to the people. These papers may be seen as a preliminary effort towards the end, when efficient and modern grades and standards of rice will be effectively introduced for the Ministry of Food, and the country. Grades and standards need continued revision and up-gradation as well as enforcement.



## 1. INTRODUCTION

### BACKGROUND

Rice plays a significant role in the economy of Bangladesh. It is the staple food for the Bangladesh people as well as an important source of cash income. The rice trade is therefore the biggest trade in the country. Presently, Bangladesh is near self-sufficiency in food production, in particular, in rice production – the staple food of the people. Farming, especially rice farming, is the main source of livelihood of Bangladesh farmers. In recent years, the average annual total area under rice cultivation was 10.71 million ha with an annual average production of 28.03 million tons of paddy (FAO, 1997). Generally the Ministry of Food, through the DGF, procure, on the average, about 0.7 million metric tons of milled rice and 0.4 million metric tons of paddy annually. But difficulties are encountered in procuring rice, especially in the Boro season (rainy season), due to high moisture and impurities in the grain that affect rice quality. The introduction of uniform rice grading would ensure quality of produce and fixation of price according to grade. This will also encourage the producers to produce quality rice. As such, rice grading is necessary for product development and efficient marketing.

The Bangladesh Standard Testing Institution (BSTI) developed the national grades and standards for rice and paddy in 1981. The Directorate General of Food (DGF) formulated a single grade similar to BSTI for regular procurement of paddy and rice. BSTI grades and standards for rice and paddy are seldom used for the domestic market due to the difficulty in adoption and the impracticality owing to the varied interests and situations on the part of the producers, processors, consumers and the government. However, the BSTI standard is yet to be enforced by law. Grading at the private sector/millers level is mostly conducted on subjectively deduced parameters.

About 50 percent of rice/paddy production is sold by farmers either to the DGF or to the local market. The DGF purchases rice under a single grade standard. The grading system of such a nature does not provide incentives to the producers and millers to produce a superior quality of paddy and milled rice. The existing incentives are usually given to promote quantity buying rather than quality buying.

Due to any changes in procurement policy, the government may like to review some of the requirements of the grades and standards for large-scale procurement. To make government procurement and over all rice marketing more efficient, a clear system of grades and standards needs to be introduced and enforced in phases throughout the country. The DGF, being the dominant buyer in the rice market, is best positioned to take the lead in upgrading the grade specifications. A modern, export oriented rice trade will require a more discriminating grading system.

In this context, the Ministry of Food had initiated a study to review existing DGF procurement standards and to incorporate improvements in order to develop workable quality grades and standards for milled rice both for domestic and international markets. With these ends in view, a research program has been undertaken to review the whole gamut of these issues with the following objectives:

#### OBJECTIVES OF THE STUDY

- 1) To review existing DGF procurement grades of rice.
- 2) To review the existing grades of the Asian region, particularly of Thailand, Pakistan, and India and also of the USA.
- 3) To devise modern standard grades, and
- 4) To recommend ways to implement procedures to ensure standards and grades of rice in the domestic as well as international export and import markets.

#### EXPECTED OUTPUTS

An implementable and modern system of grades and standards of rice for the domestic and international markets will be available.

A detailed implementation procedure for grades and standards will be ready at hand. Trained technical manpower of the DGF will be available to implement these issues. The food laboratory of the DGF will be strengthened and the library of the DGF will be modernized with periodicals and books.

#### METHODOLOGY

The study was carried out through: i) desk surveys ii) field surveys and iii) laboratory analysis of collected rice samples from different LSDs and rice mills. A study group visited seven LSDs and collected rice samples from Rohonpur of Nawabganj, Mirzapur of Bogra, Golapbagah of Gaibandha, Akkalpur of Joypurhat, Pirganj of Thakurgaon and Monmothpur and Birol of Dinajpur districts.

In addition to this, rice quality information and samples were collected from rice mills (huller and auto mills) of Sylhet, Chittagong, Mymensingh, Pabna, Naogaon, Chapai Nawabganj, Rajshahi and Dinajpur districts.

## **2. AN OVERVIEW OF RICE GRADING, INSPECTION AND MARKETING IN THE SELECTED ASIAN COUNTRIES AND THE USA.**

Many countries in Asia have developed, implemented, and some are in the process of establishing, an effective grading system that can assist in determining the value of food grains purchased from the farmers. In the following sections the rice grading systems of the selected Asian countries and the USA have been described.

### **BANGLADESH**

Rice, known botanically as "*Oryza sativa*, L.," is produced in a huge quantity in Bangladesh and is consumed by the people as a staple food. The yearly average production has ranged from 17.68 to 23.08 (Appendix 2.1.1) million tons of milled rice since 1996-2000. Major varieties of rice with varying intrinsic quality are found in the market. To facilitate internal and external trade, a grade standard was followed by the Food Department for the procurement of rice from the market.

The standard specification for a particular category of food item was first introduced in the country as the Bengal Food Adulteration Act 1919 and the Assam Pure Food Act, 1932 as the repeal of Bengal Act IV and the Assam Act 1, 1932. Afterwards in 1959 the then East Pakistan Government promulgated an ordinance vide East Pakistan Ordinance No. LXVIII of 1959 entitled the East Pakistan Pure Food Ordinance 1959 (E. P. Ord. 1959). The main objective of the Ordinance was to provide for the better control of the manufacture and sale of food for human consumption. The Pure Food Rules of 1967 states that food grains for human consumption shall be clean, dry and free from moulds. It shall be free from damage (by insect or otherwise) bad smell, discolorations and admixture with deleterious and toxic materials. Under this ordinance there were several laws and bylaws that proclaimed the prohibition of manufacture or sale of food not of proper nature, substance and quality. This ordinance was revised in 1967 and

renamed as the East Pakistan Pure Food Rules, 1967. The power of implementation was conferred to the then Health Department. The East Pakistan Pure Food Rules for food grains, cereals and their products remained unchanged after Bangladesh independence and was renamed as the Bangladesh Pure Food Rules, 1967 (Appendix 2.1.2).

Parameters of the standards for cereal were color, smell, taste, foreign matters, damaged grains, insects, sound grain and moisture content. Under these rules, all government procurement and import of paddy and rice were administered by the then Food Department. The Bangladesh Pure Food Rules, 1967 remain in force up to 1986. There were no separate rules for rice as well as paddy before 1986.

Afterward, the Bangladesh Standard and Testing Institution (BSTI) adopted the "Bangladesh Standard Specification for Grades on Milled Rice" in 18 December 1986 (Appendix 2.1.4). The draft specification was finalized by the Cereals, Pulses and their Products Sectional Committee and afterwards it had been approved by the Agricultural and Food Products Divisional Council of Bangladesh (Appendix 2.1.4 and 2.1.5).

Besides BSTI standards, the Directorate General of Food (DGF) followed some standards for procurement of paddy and milled rice. The parameters included in the procurement standards are more or less similar to those of the BSTI (Appendix 2.1.6).

## INDIA

India is inhabited by about 1 billion people. About 70% of the population is rural based and agriculture engages two-third of the total work force. Food grains constitute nearly 75% of the total agricultural output. Rice and wheat, the staple diets, comprise more than two-thirds of total foodgrain production. Like Bangladesh, there exist innumerable rice varieties abundantly grown in India, hence varietal classification is difficult. With the state entering into the rice trade, however, some grouping of varieties became necessary for purposes of pricing as well as for adopting quality standards. Grouping categories found convenient, such as 'Fine', 'Medium' and 'Coarse' were adopted in the early years of state trading. Later on, as availability became relatively

difficult, pricing, and consequently classification, became relatively intricate. More groups, such as 'Superfine', etc were then added to the existing groups. However, the Government of India recommended the following basis of classification in 1967.

- (i) Long slender .. Length 6 mm and more. Length/breadth ratio greater than 3.
- (ii) Medium slender .. Length less than 6 mm. Length/breadth ratio 2.5-3 or length less than 4.5 mm. Length/breadth ratio 2-2.5.
- (iii) Short slender .. Length less than 6 mm. Length/breadth ratio 3 and greater than 3.
- (iv) Long bold .. Length 6 mm and more. Length/breadth ratio less than 3.
- (v) Short bold .. Length less than 6 mm. Length/breadth ratio less than 3.

Items taken into account for assessing quality and value of paddy are foreign matter content, admixture of lower varieties, proportion of damaged kernels and moisture content. Invariably, paddy at the time of marketing has a foreign matter content varying between 1.5 and 3.0 percent and moisture between 16 and 22 percent. For excess foreign matter, the buyer arranges screening of the grain at the sellers cost. The agencies of government have introduced the arrangement lately, but this is limited to purchases on government accounts. The moisture content is, therefore, judged on an ad hoc basis by the buyers and an excess quantity is taken from the seller as a compensation for excess moisture.

Scented varieties are required to be placed in an appropriate class on the above basis and then allowed a premium price for their flavor. "Basmati" rice produced in the Punjab, Haryana and Uttar Pradesh is considered a choice variety of the country. This, however, appears to have gained popularity only in the northern parts of the country. In the southern part, this variety hardly finds favor. "Basmati" rice from India, because of its flavor and cooking quality (length becomes doubled on cooking), is also a favorite variety in many countries outside India.

Quality specifications adopted by each state for paddy and rice have been different. An effort has been made in 1968-69 to introduce a uniform pattern of quality assessment. A common specification developed for slender and bold-varieties of rice is given in Appendix Table 2.2.1.

High-polishing of rice, apart from rendering a substantial portion of the rice production not being available for human consumption, deprives the consumer of the nutrients that exist in the bran portion. Works on record show a degree of milling of the order of 3 to 5 percent as desirable from the point of view of nutrition and storage. Rice milled to this extent is also expected to meet the tastes of those who are accustomed to consuming hand-pounded rice.

With the introduction of machine-milling of rice, consumers, particularly in urban areas, do not consider a rice satisfactory unless it is sufficiently white in appearance. The demand of these consumers is satisfied only when rice is polished to a degree of 10 to 12 percent. Rice milled in a huller, unless subjected to a high degree of milling, does not develop a satisfactory appearance and also is not completely freed of paddy. Subjecting the rice to a high degree of milling, more or less, has therefore been a general practice. The government, taking into account difficulties encountered in obtaining sufficient quantities of rice to meet the consumer and being advised on the technical side that under-milled rice is better from nutritional angle, has made polishing (milling) of rice to a degree in excess of 5 percent an offense.

The Food Corporation of India (FCI) and state agencies follow Fair Average Quality (FAQ) standards for the procurement of wheat, rice and paddy. These standards define the tolerance limits for the different quality parameters. Produce having an excess of these limits is also procured by government agencies subject to a predetermined quality cut for graded levels of tolerance up to a maximum limit (rejection limit) beyond which foodgrains are rejected.

The Prevention of Food Adulteration Act (1954) (PFA) has laid down standards for specifying maximum limits of admixture of hazardous substances including poisonous varieties of seeds, insecticides and pesticides injurious to human health, in addition to grains damaged by fungus/moisture/heating, weavilled grains, rodent hair, etc. This Act also guards against adulteration of food grains with inferior quality and/or cheaper substances, filthy, putrid, decomposed material, materials kept under unsanitary conditions, contaminated material, etc. Some of the quality parameters like moisture content, foreign matter, damaged grains, etc. are covered by both FAQ and PFA standards. While the permissible limits for common parameters are more precisely defined in FAQ standards, the PFA standards guard against the presence of hazardous substances that are not covered by FAQ. In practice, a combination of both standards is followed for procurement.

The rice should be in sound merchantable condition, sweet, dry, clean, of good food value, uniform in color and size of grains and free from moulds, weevils, obnoxious smells, admixtures of unwholesome poisonous substances, argemone mexicana an *kesti* in any form, or coloring agents and all impurities except to the extent in the schedule given in Appendix Table 2.2.2. It should also conform to PFA standards.

In order to ensure a smooth procurement operation, rice can be purchased in addition to the maximum limit prescribed in the single grade specification in respect to the following items of refractions:

**(i) Damage/slightly damaged grains:** Damaged/slightly damaged grains are accepted up to 3% only in respect of raw rice. There is no cut up to 2%. Between 2% to 3% a cut is applicable at the rate of 1/2 value (half value cut).

**(ii) Small brokens:** The small brokens percentage, without any change in the percentage of overall brokens, is procured up to a maximum of 2%. Up to 1% there is no cut. Between 1% and 2%, the value cut is applicable at the rate of 1/2 value (half value cut).



(iii) **Dehusked grains:** The dehusked grains are accepted up to 13% for all groups of rice with value cut. There is no cut up to 10%. Above 10% to 13% a cut is applicable at the rate of 1/4 the value (one-fourth value cut).

(iv) **Moisture content:** The rice is procured up to a maximum of 15% moisture content with value cuts (raw and par-boiled). There is no cut up to 14%. Between 14% and 15%, a cut is applicable at the rate of full value.

In international sales, rice is principally graded and priced on the basis of broken contents and degree of milling. This rice is generally highly polished. Technically, broken rice is not likely to be inferior in nutritive contents in comparison with whole rice. It is possible, however, that rice containing a higher proportion of brokens will have low storability and an unsatisfactory cooking quality. Appearance, of course, is considerably affected when the broken content of rice increases. Rice varieties containing brokens from 0 to 55 percent are marketed. In India, normally the broken content ranges between 5 and 40 percent.

The degree of milling in international transactions is categorized as: under-milled, meaning the degree of milling is lower than 5 percent; medium-milled, meaning the degree of milling is in the range of 5-8 percent; and well-milled, meaning the degree of milling is higher than 8 percent.

## NEPAL

Nepal has been a traditional exporter of foodgrains, particularly of rice. The main importers of Nepalese rice are India, Bangladesh and the Tibet Autonomous Region in China. There is no apparent practice of grading of paddy and rice at the farm level and the same applies to private traders and millers. Grading at the private traders' and millers' level is either subjective or ignored.

The grading system in Nepal was first introduced by the Grain Testing Laboratory in 1970, and was adopted by the Agricultural Marketing Corporation, now called the Nepal Food Corporation (NFC), for procuring paddy and rice from farmers and millers

for export and domestic consumption. The major activities of the NFC include the purchase of foodgrains from the food surplus Terai region and its distribution in food deficit areas of the Kingdom in the hills and mountains. The NFC also acts as the government's agent to ensure effective execution of its food policy i.e. to support the minimum price of grain fixed by the government.

The NFC buys paddy directly from farmers and, in some areas, through the cooperatives. In rice procurement, the NFC buys rice up to rejection limits with price reduction, as production levy from millers. Fine rice is downgraded as coarse rice (medium and bold varieties) if the admixture of coarse rice in fine rice exceeds 10%. In the analysis of rice and paddy, sampling is done on International Standard Organization 950 1569 (E) recommendations. Different factors are determined after separating by visual inspection.

For its procurement scheme, the NFC has its own grading standards for paddy, rice, wheat and maize etc. The rice grading factors in Nepal include moisture content, foreign matter, broken rice, damage grain, discoloured grain and red grain etc. The quality standards of paddy and rice are given in Appendix 2.3.1. The NFC imposes a price cut if the factors exceed the tolerance limits as indicated in Appendix Table 2.3.2.

### MYANMAR (BURMA)

In Burma, out of the total amount of the GDP, 36% is of agriculture and almost 70% of the total export is attributed to agricultural products of which over 50% is rice and rice products.

#### *Burma Paddy*

The main types of paddy varieties extensively produced in the country are:

- |     |                       |                                |
|-----|-----------------------|--------------------------------|
| (1) | Special Emata type    | attractive thin and long grain |
| (2) | Emata type (ordinary) | thin and long grain            |
| (3) | Ngasein type          | medium grain                   |

- |     |                |                                |
|-----|----------------|--------------------------------|
| (4) | Meedon type    | thick and short grain          |
| (5) | Ngakywe type   | thick and short grain          |
| (6) | Kaukhnyin type | glutinous thin and long grain. |

### *Burma Rice*

Emata is well known in the trade sector as "Sughandi" rice. An Indian name, "Su" means good and "Ghandi" means smell. The rice, when cooked, gives a pleasant aroma that stimulates one's appetite. Special Emata is better than ordinary Emata, another variety that is largely consumed by the farmers and workers in Ngasein. The above varieties belong to the Indica type and are used primarily for export and local consumption. Meedon and Ngakywe are short and bold. They belong to the Japonica type. Their production is less. Ngakywe is most favored for its softness, flavor, and good taste.

Burma, being a major exporter of rice, used to produce as many as sixty grades of rice and rice products. The following 28 grades of rice and rice products are available in the international market.

(1)	Emata Super	5%
(2)	Emata Super	10%
(3)	Emata Burma	15%
(4)	Emata Burma	25%
(5)	Emata Loonzain (special)	5%
(6)	Yahine S.M.S.	35%
(7)	Ngakywe Burma	15%
(8)	Meedon Burma	15%
(9)	Zeera Super	5%
(10)	Zeera Super	10%
(11)	Zeera Burma	15%
(12)	Zeera Burma	25%
(13)	Bingala	35%
(14)	Dawebyan S.M.S.	35%
(15)	Ngasein Burma	15%
(16)	Ngasein Burma	25%
(17)	Ngasein S. M. S.	35%
(18)	Loonzain (special).	5%

(19)	Long boiled	10%
(20)	Milchar No. 1	8%
(21)	Ngasein Full Boiled	12%

**Broken Rice**

(22)	A Extra
(23)	AI & Extra
(24)	AI & 2 Mixed
(25)	A2, 3 & 4 Mixed
(26)	B1 & 2 Mixed
(27)	B2, 3 & 4 Mixed
(28)	Ordinary 2, 3 & 4 Mixed

---

Note: Percentage indicates amount of broken in the material.

Source: Tun U than 1985.

Broken rice has been treated as a grade of rice. The types of rice, their definitions, specifications of white, Loonzain and broken rice have been presented in Appendix 2.4.1.

## PAKISTAN

Rice is one of the most important crops of Pakistan. It produces about 3 million tons of rice annually. It is recorded as the highest foreign exchange earner, contributing about 20% of the total foreign exchange of the country. It may be mentioned that Pakistan ranks as the third biggest rice exporter in the world after Thailand and the USA. About 40% of the total production of rice is procured for export and the rest is consumed locally. It is for this reason that the Government of Pakistan, through the Rice Export Corporation of Pakistan Ltd. (RECP), has completed an extensive quality assessment of exportable varieties of rice to keep up its status and distinction in the world market.

Rice is procured from the provinces of Punjab and Sind under the monopoly and voluntary procurement schemes through the rice dealers/millers appointed by the Food Departments. They purchase paddy either from farmers or middleman called "ARTHI". This rice is then sold to RECP at the agreed quality specifications. Food Inspectors working with RECP are responsible for checking the rice quality as tendered by authorized dealers. Super checking teams also ensure that rice is obtained strictly according to specifications.

*Inspection and Grading at Procurement Centres*

Inspection of a rice lot before packing is done by Food Department officials in bulk before issuing the disposal order for delivery to railhead. Food inspectors posted at procurement centers are responsible for the inspection of rice lots tendered by the authorized dealers and if the rice is in accordance with the agreed specifications then it is accepted and despatched by wagons and NLC trucks to RECP's godowns located at Karachi.

*Sampling and analysis*

The objective of grain analysis is to accurately determine the quality of a sample. Spot analysis is carried out by the food inspector of the RECP in the presence of the representative of the authorized dealer. Ten grammes of the composite sample are taken for the spot analysis. The sample is spread out on the black tray and picking by hand is done to separate all the refractions (quality factors) viz: brokens, red, under-milled, chalky, foreign matters, paddy and other varieties etc. and, after analysis, the separated materials are weighed by physical balance and their percentage are calculated.

Standard specifications for Basmati white and parboiled special quality of Basmati and Irri-6a are presented in Appendix Tables 2.5.1 to 2.5.3.

*Weighment*

Rice is tendered in a standard weight of 95 kg nett. in B/twill new gunny bags. After accepting the rice quality-wise, 10% check-weighments are carried out after the selection of bags at random. Since the rice is purchased by the RECP, it is on the discretion of their representative to select the bags for weighment. Whrn the weight is found to be correct, the authorized rice dealers are allowed to load these bags in the wagons/trucks for transportation to RECP's godowns at Karachi.

*Super Check on Quality*

The Government of Pakistan is very keen to procure quality rice so the product can compete on the International Market and fetch a premium price. Thus, tough quality standards are maintained for the procurement of rice by the Rice Export Corporation of Pakistan to achieve this objective. Super Inspection Teams consisting of the Officers of the Food Department and the Rice Export Corporation of Pakistan are constituted by the Director Food, Punjab, to undertake surprise visits and thoroughly inspect purchased stocks by checking analysis work of the rice samples. The teams are also empowered to get the railway wagons/trucks desealed for super inspection. After desealing the wagons they draw the samples from the loaded wagons in the presence of the seller or Food Officials. Two samples are drawn, one for the Food Department's Secret Cell for analysis in the Appellate Laboratory and a second for the Authorized Rice Dealer. All the super inspected samples with assigned code numbers are routed through the Secret Cell to the Appellate Board for analysis. After analysis the Incharge of the Secret Cell decodes the number and the Appellate Board imposes necessary quality deductions on the suppliers. The Director of Food then recovers this money for the Rice Export Corporation of Pakistan. The wagons despatched from various parts of Punjab and Sind are again checked at Karachi by Super Inspection Teams to keep the procurement staff alert/vigilant in maintaining the quality of rice during the procurement season.

## CHINA

China ranks first in the world in paddy production. Due to government policy in agricultural production and marketing, the price of rice has been stable for the last 40 years. China has grain administration institutions down to the rural areas. These institutions control procurement, transportation, grading, storage, milling and supplying. The grain administration developed multi-channel grain marketing, and farmers are allowed to sell their surplus on the free market after fulfilling the government levy.

There are four varieties of rice, namely, the Xian rice, Geng rice, Xian glutinous rice and Geng glutinous rice. The names of these varieties are based on Indica and Japonica types. The Geng variety commands a higher price. Depending on the milling degree they are classified into Super Grade, Grade 1, Grade 2, Grade 3, and Grade 4. The most important criterion in assessing the value of paddy is milling yield. The details of the grading system are described below:

### *The Grading of Rice*

#### **(a) Rice Species**

There are four species of rice according to the species of paddy.

##### **Species I:**

**Xian Rice:** A polished long-grained nonglutinous rice (indica rice) that is long and oval or long and thin shaped. It is divided into two varieties according to the grain and the harvest season:

**Early Xian Rice:** Has a bigger chalky portion at the ventral part and is less hard in texture.

**Late Xian Rice:** Has a smaller chalky ventral portion and is harder in texture.

##### **Species II:**

**Geng Rice:** A polished round-grained nonglutinous rice which is oval shaped. It is divided into two varieties according to harvest seasons:

**Early Geng Rice:** Has a bigger chalky portion at the ventral part and is less hard in texture.

**Late Geng Rice:** Has a smaller chalky portion at the ventral part and is harder in texture.

##### **Species III:**

**Xian Glutinous Rice:** A polished long-grained glutinous rice which is long and oval or long and thin shaped, opaque and has a waxy white colour and a strong glutinosity.

**Species IV:**

Geng Glutinous Rice: A polished round-grained glutinous rice which is oval shaped, opaque and has a waxy white colour and a strong glutinosity.

- i. for all the species of rice, the total tolerance of mixing with other species of rice is 5%.
- ii. The tolerance of yellow rice for all the species of rice is 2%.

**(b) Quality standard**

Depending on the milling degree, all the species of rice fall into four grades, which are Super Grade, Grade 1, Grade 2, Grade 3 and Grade 4 (Appendix 2.6.1 and Appendix Tables 2.6.2 to 2.6.5).

*Rice Marketing and Pricing*

In China, food being the most important item, the government also gives great importance to the grain administration. China has grain administration institutions from the Central Government down to the basic rural levels. The Ministry of Food and Commerce controls all operations related to procurement, transportation, storage, milling and distribution.

The Government of China procures rice grain from a surplus farmer and puts it into storage after processing in state owned mills. The government then sells it according to the demand of the market. The mills get a milling fee to the standard cost set by the government. In the early 80's the grain price was increased by 20% to give farmers an incentive to produce more grain.

The price of rice is unified everywhere in China. As the grain selling price is lower than the procurement price, it became a great financial burden for the government to subsidize the grain marketing. The Chinese government will readjust the pricing policy through improving management.



## JAPAN

In Japan rice is marketed in the form of brown rice except in special cases. Inspection and storage of rice are also carried out in this form. After having their produce inspected according to Agricultural Inspection Law, farmers must sell their produce, allocated by government, through authorized rice assemblers, after deducting the amount to be sold as semicontrolled rice. The prices for the rice procured by the government from farmers are based on the place of production, grade and inspection. These prices are based on the average price of all grades of 1st and 2nd Grade with some allowance for brands and inspection grades according to the provision of the Food Stuff Control Law. The government decides the average price of rice through discussion in the Rice Price Council every year, taking into consideration the cost of production, price of main commodities and other economic conditions, with the view to secure production of rice. The quality standard for fully milled rice of Japan is presented in Appendix Table 2.7.1.

*Method of Inspection*

Rice growers, prior to selling their produce, must have their rice inspected by the government according to the provisions of the Agricultural Produce Inspection Law (Appendix 2.7.2). The method of grading and inspection in this case is as follows:

- a. In the inspection of rice, the agricultural produce inspector will conduct the inspection according to the request made by rice producers. The inspection, according to the law, shall be conducted on the quantity, packing and grade for each kind and brand of rice according to the prescribed inspection standard on each bag or pick-up extracted sample. The majority of inspection in Japan is done in the form of brown rice.
- b. The inspection shall be made at a designated place. The applicant for the inspection must prepare for the inspection by marking or putting slips on each bag to show growers' name, variety, weight, etc. In Japan, efforts are paid to increase the inspection on bulk grain and sampling so as to make inspection more efficient. To

prepare uniform quality of rice for one lot of grains to be inspected is one of the important preparations to this end.

- c. The agricultural produce inspector shall, upon grading the quality thereof, indicate the date of inspection, grade and other necessary information on the packing or slip and give the certificate of inspection to the applicant for inspection in the specified manner.

*Inspection Standards*

- (1) There are inspection standards for brown rice, milled rice and paddy; each consists of three items, kind, brand (exclude from milled rice) and standards. The standards specify the quantity, packing and grades.
- (2) There are standards for the following items:

Brown rice	Lowland non-glutinous brown rice Lowland glutinous brown rice Upland non-glutinous brown rice Upland glutinous brown rice Brown rice for brewery
Milled rice	Medium milled rice (Reasonably well-milled) Fully milled rice
Paddy	Lowland non-glutinous paddy Lowland glutinous paddy Upland non-glutinous paddy Upland glutinous paddy Lowland non-glutinous seed paddy Lowland glutinous seed paddy Upland non-glutinous seed paddy Upland glutinous seed paddy

THAILAND

The rice standards of Thailand were established in 1957 by the Board of Trade, Ministry of Commerce, in order to control the quality of rice for exportation. The inspectors of the Board of Trade and some survey-agency members are the quality assessors. After rice samples are inspected, they are sent to the laboratory of the Board of Trade for certifying the quality and issuing the certification. Every sample is analyzed for

grain composition, grain classification, the allowance of mixture, degree of milling and moisture content. Grain composition is separated by hand and sieves. Grain classification is done by measurement of whole grain length. The mixture means contamination of red streaked kernel, chalky kernel, damaged kernel, yellow kernel, immature kernel, foreign matters, and etc. The mixture is separated by hand through visual determination. The degree of milling is considered by visual comparison of the rice sample to the standard sample. There are four aspects of quality analysis for rice in Thailand. They are:

- (i) grain quality analysis in breeding programmes,
- (ii) seed standard analysis in seed production programme,
- (iii) quality assessment of local paddy, and
- (iv) quality inspection of rice for exportation.

It is also noted that the Government of Thailand has made it mandatory for all rice mills to have a milling capacity of 25 tons per day and to have a test mill and a moisture meter for quality evaluation. The method of quality assessment would greatly facilitate the Grading Work, thus ensuring a fair price to the farmers. They grade paddy according to the export standards. Some big mills have already set up modern grain quality laboratories using standard equipment to evaluate the quality and price of paddy. At times, when there is a bumper crop and prices tend to go below the support price, the government purchases paddy from farmers using the following regulations established by the Marketing Organization for Farmers (MOF). The criteria laid down under this regulation for quality grading are:

- (i) head rice yield,
- (ii) weight deduction according to red rice contamination,
- (iii) moisture content, and
- (iv) foreign matter content.

In 1984, the King Mongkut Institute of Technology designed a milling machine by the name of "Ladgrabung 02" which can determine milling yield and assess milling quality. The government has introduced a regulation requiring all rice mills with a milling capacity of 25 tons of rice per day and above to install mechanical testing equipment for quality assessment.

Quality inspection of rice for export is the concern of the Board of Trade, Ministry of Commerce and Inspection Agencies. The rice sample is analyzed for grain composition, grain classification, allowance of the mixture, degree of milling and moisture content in accordance with the requirement of the export rice standard establishment in 1957.

A detailed explanation of quality analysis has been described in the Appendix 2.8.1. Grade standards for parboiled rice are presented in Appendix Table 2.8.2.

#### MALAYSIA

In Malaysia, the paddy grading was reviewed in 1986. The project, funded by the Government and the IDRC, is being undertaken by the Malaysian Agricultural Research and Development Institute (MARDI) and the National Paddy and Rice Board (LPN).

The present grading used by the National Paddy and Rice Board (LPN) is based on visual determination of grading factors such as immature grains, damaged grains, impurities and empty grains. A weight deduction system is used to compensate for the deficiencies in quality, including moisture.

With regard to moisture content, deduction is on samples exceeding 14 % moisture content and the rejection limit is at 25% moisture content. However, as the LPN has to buy paddy with a moisture content of more than 25%, a compromise has to be reached between the farmer and the LPN on weight cuts, etc.

This system does not satisfy the procurement of paddy as prices are fixed for good, clean and dry paddy. In addition, it does not encourage proper cleaning and drying

of grains prior to sale due to lack of incentives. Action to improve the paddy grading system is undertaken by the Malaysian Agriculture and Research Development Institute (MARDI) and the LPN. Studies on the grading factors include determination of potential milling yield, which will reflect the actual standard of the white rice.

The milled rice grading has been introduced and enforced since 1974 under the Price Control Act by the Government of Malaysia. Based on this act, all rice sold in Malaysia is classified into 16 grades. However, this system was reviewed in 1978 and short grain grades were deleted as the varieties are no longer commercially produced.

#### *Milled-Rice Grading*

The rice standards and grades were set up by the Food Technology Research and Development Centre (Food Technology Division) in collaboration with the Food and Agriculture Organization of the United Nations in 1968/1969. The voluminous technical data obtained from the studies were used in the formulation of Malaysian standards for milled rice (U Thet Zin, 1970). The standards were prepared by the Technical Committee of Standards Institution of Malaysia in which the Division of Food Technology and the National Paddy and Rice Board (LPN) were members. The standards for milled rice have been enforced in the country since 1974 under the Price Control Act.

By this act, all rice sold in Malaysia is graded into 16 grades (Appendix Table 2.9.1). Specification and grading requirements are as shown in Appendix Table 2.9.2.

Due to changes in rice production, the milled rice grading system was reviewed recently by the LPN. As short grain varieties are no longer commercially produced by farmers, the grades for short grain (C) have been deleted from the schedule. However, since this grading system was introduced long ago it is felt that it requires further review so that it will suit the quality of paddy produced currently by the farmers.

## INDONESIA

Specific quality standards have been adopted in government marketing channels since the beginning of the support price policy introduced in 1969. But, these channels cover only 10% of the total production. The National Logistics Agency (BULOG), an autonomous government agency, has adopted quality standards and inspection, and incorporated stock preservation in its operations. Similarly, this agency, in response to the huge increase in production, has set priorities in improving the rice grading system and quality standards to maintain the quality of its increasing stock and to meet the demand for better quality of rice.

The BULOG has adopted strict quality standards in its domestic procurement. Paddy or milled rice can only be accepted if they conform to the determined standard. No weight cuts or price reductions are permitted in the procurement of paddy and rice from KUD (cooperatives) or private traders. But KUDs and private traders have to accept any quality offered by farmers at a discounted price that is calculated to compensate not only for grain deficiencies but also for the cost, which would incur to improve the condition of milled rice.

1. Qualitative specifications
  - a. Free from insects, fungi/mould
  - b. Free from bad smells, sourness, etc.
  - c. Free from harmful chemical substances
  
2. Quantitative specification (Appendix Table 2.10.1)

The above quality specifications are applicable only to BULOG procurement from KUDs or private traders. Rejection or acceptance of paddy or milled rice is based on the quality assessment of independent surveyors. Rice offered will be rejected if any of the

quality specifications prescribed by BULOG does not conform to the required standards. However, the farmers may offer any quality of paddy to the KUDs or traders for these quality conditions. If so they will be paid at a discounted price that is calculated based on the weight equivalent factor for the respective quality condition and costs needed to process the paddy to meet the standard quality. There is no weight equivalent factor and discounted price in transaction between BULOG and KUDs or trader for paddy or milled rice.

It was observed that since BULOG procurement covers not more than 10 percent of the total production, the National Committee on Post-harvest of Food Crops has been assigned to overcome the post-harvest problems in all food crops, mainly rice. This committee consists of several related agencies including the Ministry of Agriculture, BULOG, the Ministry of Industry, the Ministry of Cooperatives and the Ministry of Finance.

#### VIETNAM

Vietnam is one of the largest paddy growing countries in Southeast Asia. Regarding the paddy/rice standards and grades, since a few years ago there existed an unstableness on the implementation of stated criteria, particularly the grain moisture content, impurities and mixed varieties with an increasing tendency leading to a high quantity and quality grain losses in the field of procurement, transportation, storage and processing. The following main reasons could be inferred:

- the rapid introduction of new HYV's and application of multi crops especially those harvested during the raining season.
- a large quantity of state procurement in a short time after harvesting made the quality control inaccurate.
- a lack of (1) a sound and practical system of standards and grades suitable to the new situations, (2) control facilities for all levels, particularly at village and district ones and (3) a well trained staff.

The unreasonable purchasing and selling prices added considerable obstacles to grain standardization.

The revised Vietnam standard is presented in Appendix 2.11

## PHILIPPINES

The Philippines completed a project in the eighties under the joint collaboration of the National Food Authority and the FAO. The report states that the system now ensures a better price for the growers based on the quality of paddy offered for sale. Similarly, the quality assurance personnel dealing directly with the farmers have gained the necessary competence and skill in carrying out effectively the desired appraisal procedures. It was emphasized that the proposed grading system can be enforced to meet the requirements of as many farmers as possible in the established 35 grading centres of the country.

Rice is the staple food of the Philippines contributing 74% of total food consumption. More than 30% of all agricultural lands and more than 50% of the food cropland are devoted to rice. In 1986, the country produced 2.67 metric tons of paddy per hectare.

Under these accelerated production conditions, paddy and rice grading has become a major aspect in marketing, both for local and international trade, quality assurance and in varietal improvement programmes since the 1970s. The National Food Authority is the agency entrusted with grain market stabilization, market development and industry regulations.

Quantity standards for milled rice are presented in Appendix Table 2.12.1.

Paddy and milled rice grading in the Philippines is patterned after the model rice grading system introduced by the FAO through the Inter-Government Group on Rice. This grading system includes standard definitions of terms (Appendix 2.12.2).



## USA

In the United States all new rice cultivars are developed through intensive genetic selection of all important quality attributes (Adair *et. al.* 1973). Selecting for desirable milling, cooking, eating and processing of hybrid selections, breeding lines and new varieties of rice is an essential part of responsible rice breeding programs conducted by the U.S. Department of Agriculture (USDA) and the State Agricultural Experiment Stations in Arkansas, California, Louisiana, Mississippi and Texas. New varieties developed in these programs must meet established standards for the milling, cooking, eating and processing qualities required of their particular grain type before they are released for commercial production (Adair *et. al.* 1973; Webb *et. al.* 1972; Webb 1975).

Another major factor that influences rice quality is the environment under which the plant is grown. Once a new variety is released for commercial production, it will be used wherever it can be produced advantageously in comparison with currently grown varieties. Consequently, before release, each new variety is extensively tested agronomically and for quality for its likely production area. In the United States, tests are carried out in the Uniform Rice Performance Nurseries and other trials in each of the rice producing states. These trials provide the means for evaluating the quality characteristics of each new variety within environmental and modifying influences such as soil, climate and cultural conditions.

Some of the factors affecting the grade of a particular lot of rice, including grain type, moisture, chalkiness and milling yields, are discussed in the previous sections of this chapter. Other equally significant factors involved in establishing rice grades include degree of milling, color, dockage (impurities), damaged kernels, red rice, odors, and seeds or kernels of any plant other than rice.

Details of United States Standards for milled rice are presented in Appendices 2.13 and 2.13.1 to 2.13.4

### 3. COMPARABLE CRITERIA OF RICE GRADING IN ASIA AND USA

#### DEFINITIONS OF SOME TERMINOLOGIES USED IN THE RICE STANDARDS OF SOME COUNTRIES

CHINA, PR	MYANMAR	PHILIPPINES
Long shaped rice Round shaped rice	Types of rice: Ngasein, Emata, Zeera	Long grain = rice grain with 80% or more of whole milled rice grains having a length of 6.0 mm. and above Medium grain = rice grain with 80% or more of whole milled rice grains having a length of 5.0 to 5.9 mm. Short grain = rice grain with 80% or more of the whole milled rice grains having a length of less than 5.0 mm.
Brokens = 2/3th of grain length Small brokens = fragments that pass through a 2.0 mm. round hole sieve but retain in a 1.0 mm. round hole sieve	Brokens = sizes vary according to grades of rice Head rice = $\geq$ 3/4th of grain length	Head rice = a grain or a piece of grain with its length equal to or greater than 8/10th of the average length of the unbroken grain. Brokens = < 8/10th of average grain length of unbroken grain.
Chalky kernels = not available	Chalky kernels = kernels with half or more of the surface area white like the color of chalk.	Chalky grains = grains, whole or broken, one-half or more of which are white like the color of chalk and brittle.
Damaged kernels = kernels damaged by diseases or insects, or stained kernels	Damaged kernels = head rice damaged by water, heat, insects fungi, bacteria or by any other means, i.e. head rice bored by insects, colored into black or other colors in one or more area, or stained or materially damaged and including yellow kernels, immature kernels, floor damaged kernels, weevil kernels.	Damaged grains = grains, whole or broken, which are distinctly damaged by insects, water, fungi and/or any other means.
Yellow kernels = kernels that turn yellow or are off-color when compared with sound kernels	Yellow kernels = deep yellow or dark brown colored rice kernels in white rice.	Discoloured grains = grains that have changed their original color as a result of heating and other means. These are also known as "yellow grains" or "fermented grains".
Foreign matter = rice bran and fragments of kernels that pass through a 1.0 mm round hold sieve = mineral matter such as stones, dirt, etc., edible and inedible seeds, and other cereals than rice.	Foreign matter = all matter other than head rice, big brokens and brokens, including dust, husk, weevil webs, straw, dead insects, sand and dirt, seeds of other plants and points.	Foreign matter = all matters other than rice grains, rice polishings and paddy, such as weed seeds and other crop seeds.
Immature kernels = kernels that are not fully developed and floury, non-transparent kernels.	Foreign kernels = types of kernels other than the specified type of kernel.	Immature grains = grains which are light green and chalky with a soft texture.
Red kernels Red streaked kernels = not available	Red streaks = the number of red streaks counted on one surface of the kernel.	Heat damaged grains = grains or pieces of grains which are materially discolored and damaged by external heat or a result of heating caused by fermentation
Milling degree = Well milled, reasonably well milled (varying according to grades of rice)	Milling degree = Extra well milled, well milled, reasonably well milled. Ordinarily milled (varying according grades of rice)	Red grains = grains which have red pericarp. Red Streaked grains = grains, whole or broken, having red streaks, the total length of which is one-half or more of the length of the grain.
		** Milling degree: Undermilled rice, Regular milled rice/1 Well-milled rice/2. Overmilled rice. /1 - lengthwise streaks of bran layers may still be present on 15% to 40% of the sample grains. /2 - lengthwise streaks of bran layers may still be present on less than 15% of the sample grains.

\*\* with specific method of checking.

THAILAND	U.S.A	VIETNAM
<p>Long grain = <math>\geq 6.2</math> mm.            Long grain class 1 = <math>&gt; 7.0</math> mm.            Long grain class 2 = <math>&gt; 6.6 - 7.0</math> mm.            Long grain class 3 = <math>&gt; 6.2 - 6.6</math> mm.</p> <p>Short grain = 6.2 mm.</p>	<p>Long grain rice = kernels that have a length/width ratio 3.0 and more.            Medium grain rice = kernels that have a length/width ratio 2.0 -2.9.            Short grain rice = kernels that have length/width ratio 1.9 and less.</p>	<p>Extra long rice = avg length <math>\geq 7.0</math>            Long rice = avg. length 6.2 - <math>&lt; 7.0</math>            Medium rice = avg. length 5.2 - <math>&lt; 6.2</math> mm.            Short rice = avg. length <math>&lt; 5.2</math> mm.</p>
<p>Whole kernels = unbroken kernels and brokens that are 9/10th of grain length.            Head rice = <math>\geq 8/10</math>th of grain length.            Brokens = <math>&lt; 8/10 - 2.5/10</math>th of grain length, varying according to grades of rice.            Small brokens C1= fragments that pass through a 1.75 mm. round hole metal sieve.</p>	<p>Brokens = <math>&lt; 3/4</math>th of grain length.</p>	<p>Brokens = <math>&lt; 3/4</math>th - 1/4th of avg grain length, varying according to grades of rice.            Chips = fragments that pass through a 1.5 mm. round hole sieve but not through a 1.0 mm round hole sieve.</p>
<p>Chalky kernels = rice kernels that have an opaque area like chalk as form half kernel.</p>	<p>Chalky kernels = whole or broken kernels of rice which are one-half or more chalky.</p>	<p>Chalky kernels = kemels with 3/4th of the surface or more bearing a white color like chalk.</p>
<p>Damaged kernels = rice kernels that are obviously damaged as can seen by the naked eye due to moisture, heat, fungi insects or other.</p>	<p>Damaged kernels = whole or brokens which are distinctly discolored or damaged by water, insects, heat or any other means and parboiled kernels in nonparboiled rice</p>	<p>Damaged kernels = kernels of obviously poor quality due to infection by weevils, fungus and other causes.</p>
<p>Yellow kernels = rice kernels that have some yellow parts of the kernels. This includes parboiled rice kernels that are partly or wholly light brown.</p>	<p>Heat-damaged kernels = whole or brokens which are materially discolored and damaged as a result of heating and parboiled kernels in nonparboiled rice which are as dark as, or darker than, the interpretive line for heat-damaged kernels.</p>	<p>Yellow kernels = kernels with a part or all of its inner bearing a yellow color.</p>
<p>Foreign matter = other matter than rice. This includes rice husks and bran detached from rice kernels</p>	<p>Foreign material = all matter other than rice and seeds. Hulls, germs and bran which have separated from the kernels of rice shall be considered foreign material            Seeds = whole or broken seeds of any plant other than rice.</p>	<p>Foreign matter = any matter which is neither rice nor paddy.            (Inorganic or Organic)</p>
<p>Undeveloped kernels = rice kernels that do not develop normally as should be and are flat without starch</p>	<p>Objectionable seeds = seeds other than rice except seeds of Echinochloa crusgalli (commonly known as barnyard grass watergrass and Japanese Millet)</p>	<p>Red kernels = kernels with at least 1/4th of the surface covered with a bran layer bearing a red colour and the inner having the same red color.</p>

THAILAND	U.S.A	VIETNAM
Undeveloped kernels = rice kernels that do not develop normally as should be and are flat without starch	Objectionable seeds = seeds other than rice except seeds of <i>Echinochloa crusgalli</i> (commonly known as barnyard grass watergrass and Japanese Millet)	Red kernels = kernels with at least 1/4th of the surface covered with a bran layer bearing a red colour and the inner having the same red color.
Immature kernels = rice kernels that are light green, obtained from immature paddy.	Red rice = whole or broken on which there is an appreciable amount of red bran	Red streaked kernels = kernels with less than 1/2th of their surface covered with a bran layer taking a red color
Red kernels = rice kernels that have red bran covering the kernels wholly or partly.	Milling degree: the degrees of milling for milled rice of "well milled," "reasonably well milled" and "lightly milled" shall be equal to or better than that of the interpretive line samples for such rice.	Milling degree = Extra well milled, well milled, ordinarily milled, under milled
Other seeds = seeds of other plants than rice.	Interpretive line samples showing the official scoring line for factors that are determined by visual observation shall be maintained by the Standardization Division, Federal Grain Inspection Service, U.S. Dept of Agriculture, and shall be available for reference in all inspection officers that inspect and grade rice.	** Under milled kernels = kernels with more than one-fourth of the surface covered with a bran layer or still having more than four streaks along the length of the rice kernel.
Undermilled rice = rice kernels that have the milling degree below that specified for each grade of rice.		
Milling degree = Extra well milled, Well milled, reasonably well milled, ordinarily milled (varying according to grades of rice)		

\*\* with specific method of checking.

INDIA	PAKISTAN	BANGLADESH
Long grain = 6.2 m.m.	Extra long grain = $\geq 7.00$ mm. Long grain = $\geq 6.0$ mm. - 6.9 mm. Medium grain = $\geq 5.0$ mm. - 5.9 mm Short grain = $\leq 5.0$ mm.	Extra long grain = $> 7.00$ mm. Long grain = 6.0 mm. - 6.99 mm. Medium grain = 5.0 mm. - 5.99 mm Short grain = $\leq 5.0$ mm. Shape Length/Breadth Slender = $>3.0$ Medium = 2.4 - 3.0 Bold (Coarse) = 2.0-3.39 Round = $<2.0$
Broken = $<2/3$ th of grain length Fragments = $<1/4$ th of grain length	Head rice = $\geq 8/10$ th of grain length. Broken = $3/4, 1/2, 1/4$ th of grain length, varying according to grades of rice Small broken = $\leq 2/10$ th of grain length.	Head rice = $\geq 8/10$ th of grain length. Broken = $\geq 1/2$ th, of grain length Small broken = $\leq 1/4$ th - $<1/2$ th of grain length.
Chalky kernels = kernels that at least half of which are milky white in colour and brittle in nature.	Chalky kernels = kernels of which 50% or more of the surface area white like the colour of chalk.	Chalky kernels = Kernels, whole or broken, one half or more of the surface of which is white like the colour of chalk.
Damaged kernels = kernels, whole or broken, that are internally damaged	Damaged kernels = kernels of which 25% or more are distinctly discoloured or damaged by heat, water, disease, insects or other means.	Damaged kernels = Kernels, whole or broken, which are distinctly damaged by insects, water, fungi or any other means which materially affect the quality of the grains.
Discoloured kernels = kernels, whole or broken, that are discoloured materially affecting the quality.	Yellow kernels = kernels of which 25% or more the surface area have turned yellow in colour.	Yellow kernels = kernels of which 25% or more the surface area have turned yellow in colour.
Foreign matter = include dust, stones, lumps of earth, chaff, stem or straw and any other impurity.	Foreign matter = all materials other than rice kernel, bran or paddy.	Foreign matter = all matter other than rice kernels, rice polishing and paddy.
Other rice = contrasting and/or inferior varieties of rice.	Green rice = kernels of green colour in Cargo (Brown) rice which when broken are also green in colour from inside or in the endosperm.	Green rice = Kernels, whole or broken, which are unripe and under developed.
Red kernels = kernels, whole or broken, which have 25% or more of their surface coated with red bran.	Shrivelled kernel = kernels which are spearlike in shape and whose widths are distinctly thinner than normal.	
** Dehusked grains = kernels, whole or broken, that have more than $1/4$ th of the surface of the area covered with the bran.	Red striped kernels = kernels of which 25% or more of the surface area are covered with outer red bran layer.	
Milling degree = Well milled, Reasonably well milled (varying according grades of rice)	Foreign grains = seeds other than rice such as wheat pulses, etc.	Foreign grains = Head rice and broken other than the variety concerned.
	Undermilled rice = rice which is not equal to the milling requirements for "extra well milled," "well milled," "reasonably well milled" or "Ordinarily milled" as defined under Grades of Milled rice for milling degree	
	Milling degree = Extra well milled, well milled, reasonably well milled, ordinarily milled (varying according to grades of rice)	Milling degree = husked rice, undermilled rice, reasonably well milled, well milled, extra well milled.

\*\* with specific method of checking

COMPARISON TABLE OF PHILIPPINES RICE SPECIFICATIONS AGAINST, THAI, VIETNAM AND PAKISTAN

Specification	Philippines		Thailand		Vietnam		Pakistan	
	Grade 1	Grade 2	15% broken	25% broken	15% broken	25% broken	Grade 3 15-20% broken	Grade 4 20-25% broken
Whole kernels (min %)	NS	NS	55.00	40.00	50.00	50.00	} NS	} NS
Head rice (min %)	80.00	65.00	NS	NS	NS	NS	} 80-85	} 75-80
Broken (max %)	19.75	34.50	17.00	28.00	16.00	27.00	15-20	20-25
Small broken/chips/brewers (max %)	0.25	0.50	/1 1.00	/1 1.00	Nil	0.30	-	-
Damaged grains (max %)	0.25	0.50	1.00	1.00	/3 0.50	/3 2.50	} 4.0	} 5.0
Discoloured/yellow grains (max %)	2.00	4.00	1.00	1.00	1.00	1.00	}	}
Chalky grains (max %)	} 5.00	} 10.00	7.00	7.00	7.00	8.00	8.00	10.00
Immature grains (max %)	}	}	/2 0.40	/2 1.00	0	0.50	-	-
Undermilled grains (max %)	NS	NS	} 5.00	} 5.00	-	-	-	-
Red grains (max %)	0.25	0.50	}	}	} 2.00	} 5.00	-	-
Red streaked grains (max %)	3.00	5.00	}	}	}	}	3.50	4.00
Foreign matter (max %)	0.10	0.20	/2	/2	/4 0.20	/4 0.40	1.00	1.20
Paddy (max No./kg)	8	10	15	15	25	30	0.60%	0.80%
Moisture (max %)	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
Milling degree	WM/RM	WE/RM	FWM	RWM	WM/RM	WM/RM	RWM	RWM
Size of broken (Of Avg. Length of unbroken kernel)	<8/10 <sup>th</sup>	<8/10 <sup>th</sup>	<6.5/10 <sup>th</sup>	<5/10 <sup>th</sup>	<6.5 <sup>th</sup>	<5/10 <sup>th</sup>	<3/4 <sup>th</sup>	<3/4 <sup>th</sup>
Grade Equivalence	Slightly better than Thai 15%, Viet 15% and Pk 15-20%	Equivalent to Thai 25%, Viet 25%, and Pk 20-25%	↓	↔	↓	↔	↓	↔

Notes: NS =Not specified : WM = Well milled, RM = Regular milled; RWM = Reasonably well milled.

/1 = Inclusive in total broken

/1 = Immature kernels, Undeveloped kernels, other seeds and foreign matter, either singly or combined are categorized together as one item.

/3 = Total immature + Damaged kernels, but tolerance for immature grains not exceeding the specified limit.

/4 = Of which the organic foreign matter is 0.02% max.

↓ = Slightly lower than Philippino Grade 1 ↔ = Equivalent of Philippino grade 2

**COMPARISON TABLE OF BANGLADESH RICE SPECIFICATIONS AGAINST INDIA, NEPAL AND PAKISTAN**

Specification	Bangladesh	India	Nepal	Pakistan
	Single parboiled	Parboiled	Parboiled	IRRI parboiled
Whole kernels (min %)	NS	NS	NS	NS
Head rice (min %)	NS	NS	NS	NS
Broken (max %)	8	15-17	16-20	14
Small broken/chips/brewers (max %)	2-4	NS	NS	1
Damaged grains (max %)	1	4	3-5	}1.5
Discoloured/yellow grains (max %)	1-1.5	8	4-8	}
Chalky grains (max %)	NS	NS	NS	3
Immature grains (max %)	1	NS	NS	NS
Undermilled grains (max %)	NS	NS	NS	}2
Red grains (max %)	NS	4	5-7	}
Red streaked grains (max %)	NS	NS	NS	NS
Foreign matter (max %)	0.3	0.5	0.5	}0.5
Paddy (max No./kg)	1	NS	NS	}
Moisture (max %)	14	14	14.5	14
Milling degree	Well milled	Well milled	Well milled	RWM
Size of brokens (Of Avg. Length of unbroken kernel)	<1/2th	<2/3th	NS	<3/4 <sup>th</sup>
Grade Equivalence ↓	Slightly better than India, Nepal and Pakistan	↓	↓	

NS =Not specified, WM = Well milled, RM = Regular milled; RWM = Reasonably well milled.

/1 = Inclusive in total brokens

/1 = Immature kernels, undeveloped kernels, other seeds and foreign matter, either singly or combined are categorized together as one item.

/3 = Total immature + Damaged kernels, but tolerance for immature grains not exceeding the specified limit.

/4 = Of which the organic foreign matter is 0.02% max.

↓ = Slightly lower than Bangladesh Grade

#### 4. QUALITY ASSESSMENT OF MILLED RICE IN BANGLADESH.

Quality standards for milled rice depends on the following parameters:

##### VARIETY

There are innumerable varieties cultivated throughout the world grouped according to their morphological and physiological characteristics into three subspecies; *indica*, *japonica* and *javanica*. The *caryopsis* of the *indica* group is usually long, slender and rather flat with the ratio of length to width 3.1 to 3.5:1. The *japonica* varieties have broad thick *caryopsis* with the ratio of length to width 1.4:1 to 2.9:1. The *javanica* varieties have short and wide *caryopsis* with the length almost equal to width. However, in Bangladesh, mostly *indica* varieties are being cultivated. Rice is cultivated among more than 1 million small-sized farms scattered all over the country in three seasons.

##### CLASSIFICATION OF BANGLADESH RICE ACCORDING TO GROWING SEASON

The different rice crops are classified according to their distinct and different characteristics. The characteristics of these crops are summarized as follows:

##### *Aus*

These are period fixed photo insensitive varieties that mature in 80 to 120 days irrespective of the time of sowing or planting. Although they can be grown any time of the year, best yields are obtained when the plant is sown in the period from March to May and harvested from June to August. The crop is badly infested by weeds and the quality deteriorates due to the presence of weed seeds. *Aus* crops suffer from drought, early floods and from too much rain at the time of harvest and threshing. The yield and quality suffers for these reasons also.



*Transplanted Aman*

This is the main rice crop and is grown in large areas after the aus and jute crops are harvested. A large number of varieties belong to this group of rice. The grains are, in most cases, white and fine. The Aman crop is harvested during November and December.

*Boro rice*

This class of paddy is more or less similar to transplanted Aman in crop habit as well as method of cultivation. In this case also, seed beds are made, seedlings are raised and the method of transplantation is adopted. Both red and white kernelled rice varieties belong to this class of rice. Grains are generally coarse. They are mostly awnless but there are awned as well as awntipped varieties. They generally perform better than all three classes of paddy stated above. This is because they are grown during the period when the climate is neither hot nor cloudy. The introduced varieties from Japan, China, and particularly from the IRRI, are producing very high yields.

*Aromatic*

The aromatic varieties of rice are grown in three major regions of the country although Aman varieties of rice are grown and consumed in a much larger area. Like common varieties there are innumerable aromatic varieties of rice being cultivated in the country, of which three varieties, chinigura (chiniatap), kalijira and katharibhog are widely cultivated and marketed. Both kalijira and chinigura (mainly grown in the Rajshahi region) are short/bold grains where as, katharibhog (mainly grown in the Dinajpur region) are comparatively medium/slender grains. However, all of the varieties invariably possess a strong aroma (scent), which is a unique intrinsic quality of all aromatic varieties of Bangladesh. The area planted in aromatic rice varieties is much lower than that of common rice varieties (about 23% of total rice area, Baqui et al 1997).

Farmers cultivate aromatic rice not only for home consumption for their special dishes, but also for commercial purposes. In spite of the fact that non-aromatic rice varieties (mostly modern varieties) gave a significantly higher yield compared to aromatic varieties; in most cases the returns to aromatic varieties are much higher than that of coarse rices (Baqui et al, 1997). It is reported that there is no constant demand for aromatic rice, the total area differs from year to year. It was also reported that in the years of bumper production, the price of aromatics decreased to such an extent that it does not cover the production cost. This happened due to the fact that the DGF has no mandate to buy aromatic rice from the farmers. However, farmers reported that they will cultivate aromatic rice at a greater quantity commercially if GOB/DGF makes arrangements for adequate marketing.

As major portion of the aromatic rice produced and consumed locally, farmers give little attention to quality or grading. Very little information is available about production, processing or marketing of aromatic varieties. However, information available from a study has been presented in Appendix Tables 3.1 to 3.6.

#### QUALITY CHARACTERISTICS OF RICE

Rice quality is considered to have the following meanings:

- (1) Physical quality, which determines presence of impurities and damaged kernels;
- (2) Milling quality, which refers to suitability of the grain for a particular end-use;
- (3) Cooking and processing qualities which refer to consumer acceptance and preference and also imply acceptable eating quality;
- (4) Nutritional quality, concerning all aspects of rice quality.

With the increase of world trade in rice, the need for accurate evaluation of rice quality and test procedures has been emphasized. This means that there should be some basis, such as international grades, for comparing the different rice stocks that come to a market. Presently, there are both objective and subjective methods of evaluation of rice

Table 1 — Physical Properties of Some Modern and Local Rice Varieties

Variety	Milling outturn (%)	Length (mm)	Breadth (mm)	Length/Breadth ratio	Size & Shape	Appearance
<i>Coarse varieties</i>						
BR1	72	4.9	2.13	2.3	Short bold	good
BR3	69	5.8	2.32	2.5	Medium bold	good
BR8	71	5.6	2.33	2.4	Medium bold	good
BR11	72	5.0	2.17	2.3	Medium bold	good
BR12	71	4.8	2.08	2.3	Short bold	good
BR14	70	5.9	2.26	2.6	Medium bold	good
BR17	70	5.4	2.16	2.5	Medium bold	good
BR20	71	5.0	2.17	2.3	Medium bold	good
BRR1 Dhan27	71	5.6	2.07	2.7	Medium bold	good
BRR1 Dhan31	69	5.1	2.42	2.1	Medium bold	good
BRR1 Dhan33	71	4.9	2.45	2.0	Short bold	good
HBJB-II	71	4.0	2.22	1.8	Short Round	good
HBJB-IV	68	4.5	2.14	2.1	Short bold	good
HBJB-VI	72	4.4	2.44	1.8	Short Round	good
<i>Medium</i>						
BR2	71	5.9	1.90	3.1	Medium slender	good
BR4	72	5.3	1.96	2.7	Medium bold	good
BR6	68	6.0	1.81	3.3	Long slender	v. good
BR9	71	5.6	2.00	2.8	Medium bold	good
BR10	72	5.6	1.86	3.0	Medium slender	good
BR15	68	5.5	1.96	2.8	Medium bold	good
BR16	71	6.2	2.00	3.1	Long slender	good
BR18	70	5.8	2.00	2.9	Medium bold	good
BR19	70	5.8	2.00	2.9	Medium bold	good
BR21	71	5.1	1.96	2.6	Medium bold	good
BR22	72	4.9	1.96	2.5	Short bold	good
BR23	72	6.5	1.96	3.3	Long slender	good
BR25	71	4.7	1.80	2.6	Short bold	good
BRR1 Dhan28	71	5.8	1.81	3.2	Medium slender	v. good
BRR1 Dhan29	71	5.7	1.90	3.0	Medium slender	good
BRR1 Dhan30	72	5.7	1.90	3.0	Medium slender	good
BRR1 Dhan32	71	5.5	1.96	2.8	Medium bold	good
BRR1 Dhan36	69	6.1	1.90	3.2	Long Slender	good
BRR1 Dhan39	70	5.9	1.90	3.1	Medium slender	good
IR20	71	5.1	1.82	2.8	Medium bold	good
Pajam	71	4.6	1.77	2.6	Short bold	good
Nizersail	71	4.8	1.92	2.5	Short bold	good
Latisail	71	6.1	1.90	3.2	Long slender	good
HBJB-VIII	70	3.6	1.89	1.9	Short Round	Fair
<i>Fine varieties</i>						
BR7	70	6.1	1.69	3.6	Long slender	good
BR24	71	6.0	1.58	3.8	Long slender	good
BR26	68	6.0	1.58	3.8	Long slender	good
BRR1 Dhan37	74	5.0	1.51	3.3	Medium slender	good
<i>Aromatic varieties</i>						
BR5	71	3.6	1.71	2.1	Short bold	good
BRR1 Dhan34	73	3.7	1.60	2.3	Short bold	v. good
BRR1 Dhan38	73	5.4	1.59	3.4	Medium slender	good
Katharibhog	69	5.05	1.60	3.16	Medium slender	v. good
Kalizira	72	3.85	1.55	2.48	Short bold	good
Chinigura/ Chiniatop	70	3.95	1.46	2.70	Short bold	good
Basmati (Bangladesh)	72	5.4	1.74	3.1	Medium slender	good

Source: BRR1, 2000

**Table 2 — Protein Content, Amylose Content and Cooking Properties of Some Modern and Local Rice Varieties**

Variety	protein (%)	Amylose (%)	cooking time (min)	Elongation ratio	Volume expansion ratio
<i>Coarse varieties</i>					
BR1	8.8	25.0	20.0	1.4	3.6
BR3	8.0	26.0	17.0	1.4	3.4
BR8	7.2	27.0	17.0	1.4	3.6
BR11	8.2	26.0	17.0	1.4	3.6
BR12	7.4	27.0	19.0	1.4	3.6
BR14	7.5	27.0	18.0	1.4	3.6
BR17	7.0	27.0	20.0	1.4	3.7
BR20	8.5	25.0	19.0	1.5	3.4
BRR1 Dhan27	7.0	27.5	21.0	1.3	3.4
BRR1 Dhan31	8.9	26.5	20.5	1.4	4.0
BRR1 Dhan33	8.5	25.0	22.5	1.5	4.3
HBJB-II	9.0	20.0	17	1.7	3.4
HBJB-IV	10.5	25.0	21.0	1.4	3.4
HBJB-VI	9.0	22.0	18.0	1.8	3.3
<i>Medium</i>					
BR2	7.9	27.0	17.0	1.3	3.7
BR4	8.2	25.0	17.0	1.5	3.4
BR6	7.1	26.0	17.0	1.4	3.6
BR9	7.7	27.0	17.0	1.3	3.4
BR10	8.4	26.0	16.0	1.3	3.7
BR15	7.4	26.0	18.0	1.4	3.7
BR16	7.3	27.0	18.0	1.4	3.5
BR18	8.0	27.0	21.0	1.3	3.7
BR19	7.5	26.0	18.0	1.3	3.6
BR21	8.7	25.0	15.0	1.4	3.4
BR22	7.8	26.0	18.0	1.5	3.8
BR23	7.8	27.0	17.0	1.4	3.4
BR25	9.1	25.9	19.0	1.4	4.0
BRR1 Dhan28	8.6	28.0	17.5	1.5	4.3
BRR1 Dhan29	7.0	29.4	18.5	1.4	4.4
BRR1 Dhan30	8.7	26.7	19.0	1.3	4.1
BRR1 Dhan32	7.0	26.3	18.0	1.3	3.7
BRR1 Dhan36	10.0	25.4	19.0	1.3	3.7
BRR1 Dhan39	8.4	26.6	19.5	1.3	3.7
IR20	8.4	25.0	15.0	1.6	3.8
Pajam	8.3	25.0	15.0	1.6	3.9
Nizersail	8.1	25.0	15.0	1.5	3.6
Latisail	8.9	26.0	19.0	1.4	3.4
HBJB-VIII	8.7	20.0	21.0	1.9	3.4
<i>Fine varieties</i>					
BR7	8.0	22.0	16.0	1.3	3.5
BR24	8.9	26.0	19.0	1.3	4.1
BR26	8.4	22.7	19.5	1.3	4.1
BRR1 Dhan37	10.3	23.8	20.0	1.2	3.7
<i>Aromatic Varieties</i>					
BR5	9.1	26.0	14.0	1.6	3.4
BRR1 Dhan34	10.2	23.0	13.0	1.4	4.0
BRR1 Dhan38	8.8	22.6	19.0	1.3	3.7

Source: BRR1, 2000

quality. For example, no practical objective method is available for determining odor, flavor, taste or texture, so the rice traders, processors and researchers must rely on subjective methods of evaluation. Therefore, only physical and milling qualities are described in the following sections. However, physical properties of some modern and local rice varieties are presented in Table 1. Protein and amylose content and cooking properties of some modern and local rice varieties are presented in Table 2.

### PHYSICAL QUALITY

The physical quality of rice is normally affected by the presence of:

- (1) moisture
- (2) foreign matter, which includes other food grains, varietal admixture and brokens
- (3) damaged kernels
- (4) chalky, green or red grains.

Based on physical dimensions and the shape of the rice grain, the FAO suggests a uniform standard of classifications into three subgroups, extra/long, medium, short and slender, medium, bold/round, which are presented below:

#### The FAO standard classification of milled rice

<b>Size</b>	<b>Length (mm)</b>
Extra long	More than 7.0
Long	6.0-7.0
Medium	5.5-5.9
Short	Less than 5.5
<b>Shape</b>	<b>Length/breadth</b>
Slender	More than 3.0
Medium	2.4-3.0
Bold (coarse)	2.0-2.39
Round	Less than 2.0

## MILLING QUALITY

*Milling yield*—Milling quality of paddy or rough rice directly measures its performance during the milling process, and is expressed as milling yield. Two values of milling yield are commonly used in the rice industry:

- (1) Total yield or total rice out-turn and
- (2) Head yield or whole-kernel rice yield.

Total yield is the quantity of whole and broken kernels of milled rice that can be obtained from a given quantity of cleaned paddy, and is expressed as the percent weight of the paddy. The head yield or whole kernel yield is the quantity of whole kernel rice that can be obtained by processing a given quantity of paddy. It is also expressed as the percent weight of the paddy sample.

Milling quality or milling yield is affected by the following factors:

- (1) Variety
- (2) Moisture content
- (3) Pre-treatment such as parboiling and
- (4) Processing (milling) equipment and methods.

The FAO Revised Model System for Grading Rice in International Trade (1971) defines four types of milled rice:

- (1) “under milled” in which part of the germ and most or all of the pericarp have been removed,
- (2) “reasonably well milled” in which the germ and pericarp and most of the aleurone have been removed,
- (3) “well milled” in which the germ, the pericarp, and practically all the aleurone layer have been removed, and
- (4) “extra well-milled” rice, which contains the starchy endosperm only.

## 5. AN OVERVIEW OF THE RICE MILLING INDUSTRY IN BANGLADESH

The whole of the rice milling industry in Bangladesh, consisting of about 100,405 large and small mills, is one of the largest food processing industries in the country. The salient features of these devices are presented in Table 3.

**Table 3 — Rice Processing in Bangladesh**

Rice mill	Type	Major components	Capacity	Power	Hulling/polishing	Hull, bran separation and grading	Suitable for
Village	traditional	Dheki	40 kg/day	2 women	separately by same device	manually	raw, parboiled, aromatic paddy
	mechanical (custom hire)	Engelberg huller	0.3 - 0.5 t/hr	10-20 hp	single operation	manually	parboiled paddy
Semi modern	small	soaking tank; parboiling pan; drying floor; Engelberg huller	0.5 - 1.0 t/hr	15-30 hp	single operation	manually	parboiled paddy
	large	soaking tank; steam parboiler; drying floor; Engelberg huller; cleaner	1.0 - 2.0 t/hr	20 - 40 hp	separately by same device; grading manually	hull, bran separation mechanically	parboiled paddy
Modern	small	rubber roll huller; paddy separator; polisher	0.3 - 1.0 t/hr	8 - 15 hp	separately by different devices	hull, bran separation mechanically; grading manually	raw, parboiled, aromatic paddy
	large	precleaner; soaking tank; boiler; steam pressure parboiler; dryer; rubber roll sheller; paddy separator; polisher; bran separator; grader	2.0 - 6.0 t/hr	65-100 hp	separately by different devices	all activities mechanically	raw, parboiled, aromatic paddy

Source: Baqui et al, 1994.

## PROCESSING OF RICE

Appendix 5.1 shows the flow diagram of postharvest processing operations of coarse paddy/rice in Bangladesh. All the processes are accomplished manually except milling. Over 90% of the rice is parboiled before milling. About 2.8 million tons of paddy are processed as unparboiled rice mostly in rubber roll shellers. The remaining 25.5 million tons of paddy are parboiled both in large and small rural mills. There are about 25 large automatic, 380 Chinese and 100,000 Engleberg huller mills in the country (Source: Baqui et al, 1997).

## MILLING CAPACITY

The millers begin to purchase and process rice from December and operate their rice mills from 4 to 9 months depending upon the availability of paddy in the market. For up to six months, the big rice mills usually process about 200 tons of aromatic paddy per week and the small Chinese rice mills process about 16 tons per week. This leaves a surplus milling capacity that could be used to mill for export while maintaining the level of supply to local market. Large huller and automatic rice mills each process about 1200 to 1300 tons of parboiled paddy per year. (Baqui, BRRI, 2000)

## CONSTRAINTS OF THE EXISTING RICE MILLING SYSTEM

- Use of traditional technology (threshing, drying, parboiling, aging, dehulling etc.) causes high loss and produces an inferior quality of milled rice and by-products;
- Delayed harvesting and threshing develops fissures in rice kernels;
- Use of Engleberg hullers results in high breakage and over polishing;
- Varietal mixture of paddy creates problem in milling;
- Non-effective grades standards for paddy and rice encourage millers to procure bad quality material;
- An absence of compatible marketing policy resulted in market instability;
- Non-uniform supply of paddy in the market;
- Frequent power interruption creates management problems.



### SUGGESTED IMPROVEMENT OF MILLING SYSTEM

- Quality of available paddy and rice in the market is to be assessed in order to reformulate the national grade standards;
- Modify the existing Engleberg huller by introduction/incorporating a rubber roll sheller in order to produce an acceptable quality of rice and its by-products for domestic as well as international markets.

## 6. FINDINGS FROM THE FIELD SURVEY

In order to collect relevant information on classification, grades and standards of milled rice, the study group visited LSDs of Rohanpur, Chapai Nawabganj, Mirzapur, Bogra, Golapbagh, Gaibandha, Akkelpur, Joypurhat, Pirganj, Thakurgaon, Monmothpur and Birol, Dinajpur district. Information on rice storage, godown hygiene, quality parameters at procurement, storage procedures and inspection, disposal indicators, difficulties faced by the staff of LSD during implementation, annual inspection of stock, and in-service training of the staff were collected through a structured questionnaire (Appendix 5). Photographs of the collected samples are presented in Appendix 5.2.

In addition to this, rice quality information and samples were collected from the rice mills (Hullers and Auto Mills) of Sylhet, Chittagong, Mymensingh, Pabna, Naogaon, Chapai Nawabganj, Rajshahi and Dinajpur districts.

Collected samples were analyzed in the BRRI Grain Quality Laboratory and the results are presented in Tables 4 to 9. After analyzing, the samples were grouped into four categories viz. Coarse, Medium, Fine and Aromatic varieties based on their breadth.

Coarse : Includes varieties whose breadth is more than 2.00 mm.

Medium : Includes varieties whose breadth ranges from 1.70 to 2.00 mm.

Fine : Includes varieties whose breadth is less than 1.70 mm.

Aromatic: Includes varieties that have **aroma**. The breadth of these varieties ranges from 1.55 to 1.74 mm.

**Table 4 — Quality Analysis of Milled Rice Samples (Aman, Parboiled Coarse) Collected from Selected LSD's \* DGF**

Ac#	Variety	Moisture content %	Foreign matter (%)	Whole grains (%)	Head rice (%)	Brokens (%)	Small brokens/brewers (%)	Yellow, dead and damaged (%)	Chalky and immature (%)	Paddy (%)	Other varieties (%)	Discolouration (%)
1.	Aman 2000	13.1	0.08	1.49	92.17	3.72	4.50	0.90	0.35	0	0.08	0.82
2.	Aman 2000	13.2	0.12	1.08	94.88	3.58	2.87	0.58	0.83	0	0.47	0.79
4.	Aman 2000	13.5	0.0	0.90	92.36	2.33	3.91	0.26	0.30	0	1.24	0.83
4.	Aman 2000	13.3	0.0	1.52	90.37	1.81	4.00	0.49	0.21	0	0.41	0.95
5.	Aman 2000	13.1	0	1.76	90.45	3.72	3.95	0.67	0.55	0	0.31	0.67
6.	Aman 2000	13.3	0	1.19	94.66	0.88	3.15	0.27	0.08	0.08	0.23	1.04
7.	Aman 2000	13.5	0	0.60	96.08	1.48	2.68	0.12	0.12	0	0	2.10
8.	Aman 2000	12.7	0	1.38	87.27	2.87	3.40	0.41	0.15	0.11	0.22	0.37
	Average	13.21	0.17	1.24	92.28	2.55	3.55	0.46	0.32	0.02	0.37	0.95

\* LSD's of Rohonpur, Mirjapur, Akkelpur, Golapbag, Pirganj, Birol, Manmathpur.

**Table 5 — Quality Analysis of Milled Rice Samples (Boro, Parboiled Coarse) Collected from Selected LSD's \* DGF**

Ac#	Variety	Moisture content %	Foreign matter (%)	Whole grains (%)	Head rice (%)	Brokens (%)	Small brokens/brewers (%)	Yellow, dead and damaged (%)	Chalky and immature (%)	Paddy (%)	Other varieties (%)	Discolouration (%)
1.	Boro 2000	13.1	0.0	3.10	90.05	2.45	6.81	0.27	0.69	0	1.72	0.38
2.	Boro 2000	13.6	0.79	2.28	90.48	2.52	4.95	1.10	0.20	0	0.55	1.38
3.	Boro 2000	12.9	0.04	1.22	89.78	3.99	7.06	0.34	0.59	0	0.46	0.29
4.	Broo 2000	13.3	0.04	3.31	88.55	2.98	6.08	1.83	0.0	0.08	2.27	0
5.	Boro 2000	13.0	0.0	1.40	85.45	2.96	8.94	0.38	0.0	0	0.84	5.46
6.	Boro 2000	13.4	0	1.12	90.55	0.52	5.78	0.52	0.36	0	1.51	0.96
7.	Boro 2000	12.8	0.39	1.28	90.84	2.41	3.80	0.93	0.23	0	1.24	0.66
8.	Boro 2000	13.5	0.23	0.57	90.79	0.57	4.01	0.15	0.42	0	1.95	0
9.	Boro 2000	13.5	0	1.00	92.40	1.73	4.70	0.76	0.20	0	0.76	0.52
	Average	13.23	0.17	1.7	89.88	2.24	5.79	0.70	0.30	0.008	1.26	1.07

\* LSD's of Rohonpur, Mirjapur, Akkelpur, Golapbag, Pirganj, Birol, Manmathpur.

\*\* Note: Information on breadth of these rice samples is not available.

**Table 6 — Quality Analysis of Milled Rice Samples Collected from Selected Rice Mills of Bangladesh (Parboiled-Coarse)**

Ac#	Variety	Breadth (mm)	Moisture content (%)	Foreign matter (%)	Whole grains (%)	Head rice (%)	Brokens (%)	Small brokens/brewers (%)	Yellow, dead and damaged (%)	Chalky and immature (%)	Paddy (%)	Other varieties (%)	Discolouration (%)	Underboiled
1.	BR11	2.17	13.0	0.33	89.38	90.33	6.04	3.71	0	.11	0	.44	1.78	
2.	BR11	2.17	12.3	0	89.21	89.69	4.52	4.55	0	1.35	0	0	0.42	
3.	IR-8	-	13.3	0.08	88.80	93.29	3.66	0.45	1.19	0.35	0	0.35	4.24	
	Average		12.87	0.14	89.13	91.10	4.74	2.90	0.40	0.60	0.0	0.26	2.15	

**Table 7 — Quality of Milled Rice Samples (Parboiled-Medium) Collected from Rice Mills**

Ac#	Variety	Breadth (mm)	Foreign matter (%)	Whole grains (%)	Head rice (%)	Brokens (%)	Small brokens/brewers (%)	Yellow, dead and damaged (%)	Chalky and immature (%)	Paddy (%)	Other varieties (%)	Discolouration (%)
1.	Pajam	1.77	0	91.05	91.55	3.38	3.66	0	2.86	0	2.12	.40
2.	Sharna	-	0	93.63	94.35	1.99	1.13	0	.27	0	.24	.37
3.	Pajam	1.77	0	89.98	90.58	4.07	4.23	0	3.10	0	1.71	.20
4.	Sharna	-	0	93.56	94.03	3.08	2.03	0	.31	0	0	.39
5.	Mala (BR2)	1.90	0	83.03	85.73	7.41	6.32	0	5.74	0	3.90	8.28
6.	BRR1 Dhan28	1.81	.03	94.14	95.13	3.17	2.49	0	.85	0	0	1.43
7.	Sharna	-	.04	91	92.59	3.23	3.70	0	.79	0	0	1.59
8.	BR 16	2.00	.20	92.85	94.28	4.74	1.71	0	2.19	.15	1.61	5.01
	Average		0.03	91.16	92.28	3.88	3.16	0.0	2.01	0.02	1.20	2.21

**Table 8 — Quality of Milled Rice Samples (Un-parboiled-Fine) Collected from Rice Mills**

Ac#	Variety	Breadth (mm)	Foreign matter (%)	Whole grains (%)	Head rice (%)	Brokens (%)	Small brokens/ brewers (%)	Yellow, dead and damaged (%)	Chalky and immature (%)	Paddy (%)	Other varieties (%)	Discolouration (%)
1.	Chini atap	1.46	0.05	76.80	68.9	9.92	3.1	0	2.64	0	1.63	0
2.	Atop pajam	1.77	0.0	75.60	83.74	6.95	10.99	0	2.85	0	0.41	0.13
3.	Chini atop	1.46	0.0	76.01	81.15	10	10.30	0	1.11	0	4.45	0
	Average		0.02	76.14	77.93	8.96	8.13	0.0	2.2	0.0	2.16	0.04

**Table 9 — Quality of Milled Rice Samples (Un-Parboiled-Aromatic) Collected from Rice Mills**

Ac#	Variety	Breadth (mm)	Moisture content %	Foreign matter (%)	Whole grains (%)	Head rice (%)	Brokens (%)	Small brokens/ brewers (%)	Yellow, bead and damaged (%)	Chalky and immature (%)	Paddy (%)	Other varieties (%)	Discolouration (%)
1.	Chini Atap	1.46	12.8	0.05			9.92	3.1	0	2.64	0	1.63	0
2.	Chini Atap	1.46	12.6	0	76.01	81.15	10	10.30	0	1.11	0	4.45	0
3.	Kalijira	1.55	10.9	0	6.85	72.90	2.05	17.90	0	6.80	0	5.55	0
4.	Katharibhog	1.60	11.6	0	21.70	68.80	3.15	6.00	0	0.95	0	0.60	0
5.	BRR1 Dhan34	1.60	11.9	0	26.07	59.28	13.72	3.33	0	0.78	0	1.52	0
	Average		11.96	0.01	26.13	56.43	7.77	8.13	0.0	2.46	0.0	2.75	0.0

\* Collected during visites to the selected sites of Bangladesh.

### COARSE VARIETY

Table 4 shows that the moisture content of the Aman varieties ranged from 12.7 % to 13.5 % with an average of 13.21 %. Foreign matter is negligible. Big broken ranged from 1.48% to 3.72% with an average of 2.55%. Small brokens ranged from 2.68% to 4.50% with an average of 3.55%. Other impurities, such as chalky and immature grain, yellow, dead and damaged grain, and other varieties, paddy, red rice on an average are 0.32%, 0.46%, 0.37%, negligible and 0.95% respectively.

Table 5 shows that the moisture content of Boro varieties ranged from 12.8% to 13.6% with an average of 13.23%. Big broken ranged from 0.52% to 3.99% with an average of 2.24%. Small brokens ranged from 4.01% to 8.94% with an average of 5.79%. The presence of other varieties was 1.26% and red rice was 1.07%. Other parameters are similar to Aman varieties. The total of brokens in Boro is higher (8.03%) than in Aman (6.1%). Red kernels and admixtures of other varieties are also higher in Boro than in Aman. Total brokens in Aman samples collected from rice mills are also similar to LSD samples (Table 6).

These figures of big broken, small broken and other impurities are much lower than those of India (Appendix 2.2.1 and 2.2.2), Nepal (Appendix 2.3.1 and 2.3.2), Myanmar (Appendix 2.4.1), Pakistan (Appendix 2.5.1 to 2.5.3) and the USA (Appendix 2.13).

### MEDIUM VARIETY

Table 7 shows that big brokens ranged from 1.99% to 7.41% with an average of 3.88%. Small brokens ranged from 1.13% to 6.32% with an average of 3.16%. Other impurities, such as chalky and immature grain, yellow, dead and damaged grain, other varieties, paddy, red rice on an average are 2.01%, nil, 1.2% negligible and 2.21% respectively. Foreign matter is negligible.

These figures of big broken, small broken and other impurities are much lower than those of India (Appendix 2.2.1 and 2.2.2), Nepal (Appendix 2.3.1 and 2.3.2), Myanmar (Appendix 2.4.1), Pakistan (Appendix 2.5.1 to 2.5.3) and the USA (Appendix 2.13).

#### FINE VARIETY

Table 8 shows that big broken ranged from 6.95% to 10.0% with an average of 8.96%. Small broken ranged from 3.10% to 10.99% with an average of 8.13%. Other impurities such as chalky and immature grain, other varieties present and discolored rice are, on an average, 2.20%, 2.16%, and 0.04% respectively. Foreign matter is negligible.

These figures of big broken, small broken and other impurities are much lower than those of India (Appendix 2.2.1 and 2.2.2), Nepal (Appendix 2.3.1 and 2.3.2), Myanmar (Appendix 2.4.1), Pakistan (Appendix 2.5.1 to 2.5.3) and the USA (Appendix 2.13).

#### AROMATIC VARIETY

Table 9 shows that moisture content ranged from 10.9% to 12.6% with an average of 11.96%. Big broken of un-parboiled aromatic milled rice ranged from 2.05% to 13.72% with an average of 7.77%. Small broken ranged from 3.1% to 17.9% with an average of 8.13%. Chalky and immature, other varieties and red rice kernel are 2.46%, 2.75% and nil. Foreign matter is negligible.

Considering the quality parameters of aromatic milled rice of Table 9, we found that only total broken are higher in Bangladesh (15.9%) compared to Pakistan (12.5%). Other parameters including chalky and immature kernel, admixture of other varieties, red rice kernel and foreign matters are much lower than Pakistan Basmati white rice. It may be mentioned that in Bangladesh the major portion of the aromatic rice is produced and consumed where it is produced. Therefore, farmers give little attention to quality or grading.



During LSD visits, the inspectors, Assistant Inspection of Food (AIF) and OC/LSD reported that nowadays fine grade rice is also available if a higher price is offered. As the country is progressing gradually towards near self-sufficiency in rice production, we should consider the quality of grain. The study group finds great prospects for exporting fine and aromatic rice in the near future. The survey revealed that there is a considerable amount of fine and aromatic varieties of rice being produced and marketed in the country.

Moreover, considering the quality parameters of Bangladeshi aromatic varieties of rice presented in Appendix Tables 3.1 to 3.6, the study group feels to propose selected *aromatic varieties of rice as a separate grade for both the domestic and international markets.*

DGF is procuring milled rice under a single grade (Parboiled-Coarse) during the Aman/Boro season only. They are not buying fine (parboiled) and aromatic rice already available in the market. This practice discourages the producers of fine and aromatic rice to grow more. It is reported that neighboring countries are exporting fine and aromatic grades of rice and earning foreign exchange for the country. If there is a government policy to procure fine and aromatic grades of milled rice, the country may earn valued foreign currency. However, this practice of procuring only parboiled coarse (Boro/Aman) rice may be continued for the interim period.

## **7. PROPOSED CLASSIFICATION OF MILLED RICE FOR DGF BASED ON ITS BREADTH**

Classification of rice varieties based on size and shape is universal. The majority of Bangladesh rice varieties are bold/coarse having their length of kernels below 6.00 mm. Breadth of different rice varieties is distinctly different from each other. In general observation, breadth and/or thickness provide the observer the types of grain, e.g. coarse, medium and fine (Tables 1 and 2). The particular aroma of the variety provides the class of aromatic variety. Generally, the aromatic varieties have a slender kernel. Based on the foregoing discussions, the study group feels to propose *four classes as coarse, medium, fine and aromatic for Bangladesh rice. The varieties are classified based on grain size, shape and breadth in particular.* The values of the quality parameters selected for the proposed classifications (Tables 10, 11 and 12) have been derived from the foregoing results and also the results from the Appendix Tables 3.1 to 3.6.

### **PROPOSED GRADE OF PARBOILED COARSE MILLED RICE FOR INTERIM DGF PROCUREMENT.**

The following grades are proposed for the DGF for the interim period:

**Table 10 — Proposed Grades for Parboiled (Coarse) Milled Rice**

Quality parameter	Parboiled (Coarse) Milled rice	
	Boro	Aman
1. Moisture (max) %	14	13.5
2. Big broken (max) %	8.0	8.0
3. Small broken (max) %	3.0	4.0
4. Chalky & Immature kernel (max) %	Nil	nil
5. Admixture of other varieties (max) %	5.0	5.0
6. Yellow, dead, discoloured and damaged kernel (max) %	1.0	0.5
7. Paddy (per kg) no. (max)	1.0	1.0
8. Foreign matter (max) %	0.25	0.25
9. Red rice (max.) %	2.0	2.0
10. Milling degree	well milled	well milled.

Notes: Well milled means 10% polished grain.

The Directorate General of Food (DGF) procurement criteria has 12 quality parameters including moisture content, big broken, small broken, chalky kernel, admixture of other varieties, damaged grain, immature grain, discoloured grain, paddy per kg, foreign matter, milling degree and under boiled. After analyzing the collected samples, the study group combined the chalky and immature as one parameter; dead, discoloured, damaged and yellow grain as another parameter. Therefore, the quality parameter of the proposed grade will be composed of 10 factors.

**Table 11 — Proposed Grades of Milled Rice for Future DGF Procurement (Boro)**

Quality Parameters	Parboiled			Aromatic
	Fine	Medium	Coarse	
Moisture (max.) %	14.0	14.0	14.0	14.0
Big brokens, (max.) %	4.0	4.0	5.0	12.0
Small broken, (max) %	3.0	3.0	3.0	4.0
Chalky & immature grain (max.) %	nil	nil	nil	nil
Admixture of varieties(max.) %	4.0	4.0	5.0	3.0
Damaged, dead, discoloured & yellow kernel (max.) %	1.0	1.0	1.0	2.0
Paddy per kg (max.) no.	1.0	1.0	nil	2.0
Foreign matter (max.)%	0.25	2.0	0.25	nil
Red rice (max.) %	2.0	2.0	2.0	nil
Milling degree %	Well milled	Well milled	Well milled	Well milled

Note: Well milled means 10% polished grain.

Table 12 — Proposed Grades of Milled Rice for Future DGF Procurement (Aman)

Quality Parameters	Parboiled			Aromatic
	Fine	Medium	Coarse	
Moisture (max.) %	13.5	13.5	13.5	13.5
Big broken, (max.) %	4.0	4.0	5.0	12.0
Small broken, (max.) %	3.0	3.0	3.0	4.0
Chalky & immature grain (max.) %	nil	nil	nil	nil
Admixture of varieties(max.) %	4.0	4.0	5.0	3.0
Damaged, dead, discoloured & yellow kernel (max.) %	1.0	1.0	1.0	2.0
Paddy per kg (max.) no.	1.0	1.0	nil	2.0
Foreign matter (max.)%	0.25	2.0	0.25	nil
Red rice (max.) %	2.0	2.0	2.0	nil
Milling degree %	Well milled	Well milled	Well milled	Well milled

Note: Well milled means 10% polished grain.

## 8. STORAGE AND INSPECTION PROCEDURES

In addition to existing DGF inspection procedures the following instructions are suggested for the improvement of the system.

### INSPECTION DURING PROCUREMENT

- a) Selection of Millers/Authorized dealers:
  - 1. Selection of rice mill authorized dealers is to be done following the prescribed procedures of the DGF.
  - 2. Authorized dealer is not to be disposed of to any others' party except rice.
  - 3. The authorized dealers/millers are to execute an agreement with the DGF by depositing security money.
- b) Before procurement, on duty inspectors of the DGF should visit and inspect rice lots tendered by the authorised dealers/millers/farmers to see if the rice is in accordance with the agreed specifications and if it is accepted for procurement.
- c) Lots of rice brought by the dealers/farmers must be inspected again at the LSD, to confirm with the agreed specifications and to be accepted for storage.
- d) The inspector should record source, year, season of production and designated variety (e.g. coarse fine and aromatic).
- e) Jute bags (Standard size & quality) should be inspected at the LSD site to ensure their specifications.
- f) Each bag containing supplied milled rice should be weighed. A standard bag weight should be 50 kg net.
- g) Upon inspection of the commodity, the inspector should record the date of inspection, grade and other necessary information on the lot and in the inspection book.

## h) Sampling

1. Sampling is to be carried out by the inspector of DGF from the lots in presence of the representative of rice suppliers from 5% of the bags at random according to the standard sampling procedures and thus a representative sample from the lot can be obtained. Samples so drawn from different bags should be thoroughly mixed on a smooth surface to make them homogeneous. Such samples are to be further divided into three sub-samples whose distribution is as follows:

- i) Sample No. 1 is to be analyzed on the spot.
- ii) Sample No. 2 is to be delivered to the supplier.
- iii) Sample No. 3 is to be delivered to the technical inspector at the district for final analysis.

## i) Determination of grades.

- \* Collection of unbiased samples from the lot.
- \* Sub-divide the sample to make working samples of 20 gm.
- \* Determine the moisture content by the moisture meter and correct the reading with the 105<sup>0</sup>C air oven drying method reading.
- \* Contract the samples to 20 gms and separate by hand the colored grain, discolored grain, foreign grain (other varieties) and foreign matters and work out the percentage.
- \* Contract the samples to 20 gms and separate by hand the chalky grain, damaged grain, and brokens (big and small).
- \* Determine the degree of milling (well milled, under-milled) by visual inspection.
- \* Calculate the thousand grain mass (TGM) of the sub-samples following the standard method mentioned in the training section.

## SAMPLE ANALYSIS

20 gram composite samples are to be taken for spot analysis and the following quality factors to be determined through:

- a) Moisture content (wb) %
- b) Big brokens, (Max.) %

- c) Small broken, (Max) %
- d) Chalky and immature grain (Max.) %
- e) Admixture of varieties (Max.) %
- f) Damaged, dead and discoloured kernels (Max.) %
- g) Paddy (per kg) no. (Unhusked)
- h) Foreign matter (Max.) %
- i) Milling degree %
- j) Thousand grain mass (TGM) gm

#### PRESENT DGF STORAGE AND DISPOSAL INDICATORS

While discussing existing DGF storage and disposal indicators, the concerned staff reported that present indicators, namely DACRA, DISDI etc. are not exactly applicable to the present storage commodities. As the total storage environment; including godown infrastructure, its hygiene, storage procedures, inspection and disposal system; have been gradually improved over the last few years, the stored commodities do not attain the conditions of DACRA, DISDI and EKDUM levels within 6-8 months of storage. It is reported that generally procured commodities at the LSDs are transferred/distributed/moved within 6-8 months of storage.

#### PROPOSED STORAGE AND DISPOSAL INDICATORS

To find an alternative to the existing storage and disposal indicators, the following techniques may be used after testing at the laboratory and LSD level. The techniques are:

#### DETERMINATION OF PERCENTAGE INSECT DAMAGE GRAIN

1. Take a random sample of 100-1000 grains.
2. Separate the bored grain manually.
3. Count the bored grain either manually or by using a grain counter.
4. Calculate the percentage of the damaged grain by using the following formula.

$$\frac{\text{Number of bored grain}}{\text{Total number of grain counted}} \times 100 = \% \text{ bored grain in sample}$$

This percentage is converted into percent weight loss by dividing by the conversion factor  $c$ . For milled rice the conversion factor  $c = 2$ .

#### DETERMINATION OF PERCENTAGE WEIGHT LOSS USING TGM METHOD

1. Calculate mean thousand grain mass (TGM) of representative sample
2. Determine % weight loss as follows:

$$\frac{\text{Baseline TGM (from initial sample)} - \text{Sample TGM}}{\text{Baseline TGM}} \times 100$$



## 9. IMPLEMENTATION PROCEDURES

Suggested grade standards for DGF procurement should be implemented in phases.

Suggested steps are:

- Develop a working group on new grades and standards at the district level.
- Develop a pilot program on new grade testing and try this technique in limited LSDs and procurement centers.
- The working group should identify and record practical problems and suggest probable solutions.
- The LSD procurement staff should be trained on the application of new grading techniques for procurement after piloting.
- If the pilot program becomes successful, then it may be gradually extended to other LSDs.

### PRESENT SINGLE GRADE PROCUREMENT SYSTEM AND ITS LIMITATIONS.

At present the available staff at the LSDs and the Technical Inspector at the district controller food office work together in the procurement of milled rice and paddy during the Boro and Aman seasons in a year. They collect rice samples at the receiving point (LSD) by the sample auger. The collected samples are then sub-divided into small working samples and the major the impurities are identified by visual inspection. Only the moisture content of the sample is determined using an electronic moisture meter where available. At the time of the big rush, during procurement, they only bite the grain under teeth and assess the approximate moisture content of the sampled grain. Later, when the Technical Inspector is available at the LSD, he takes the already collected samples with him and analyzes these for the quality parameters at the DC food office. If

any lot of supplied rice falls below the procurement criteria, after a detailed analysis, the lot is declared rejected and the supplier/dealer/miller takes back his lot. The staff of the LSD engaged in procurement faces difficulties in performing their duties due to various reasons. These include among others, an inadequate number of staff during procurement, including the Technical Inspector, lack of modern laboratory equipment for analysis at the LSD, local political pressure for accepting sub-standard commodities, delayed arrival of the procurement order at the LSD and a lack of regular in-service training of the staff.

Therefore, for future procurement of the proposed three grades rice (Coarse, Fine and Aromatic) at the LSD, the staff should be trained properly through regular in-service trainings. The LSDs should be equipped with modern equipment and the post of Technical Inspector should be increased to two, from the present post of one, in the district.

#### PARTICIPATORY IMPLEMENTATION PROCEDURE OF GRADES AND STANDARDS

**(i) Responsibilities of grain millers, processors or packers towards full**

**implementation of the grains standards:** Concerned grain millers, processors or packers will have to strictly observe the proper grading, packaging and labeling of their products to be sold in the market. In the packaging and labeling of their products, rules on the metric system must also be observed.

**(ii) Responsibilities of grains retailer:** Concerned retailers will have to strictly observe proper use of packaging materials, labels and price tags on their products. Information on the tags and labels must be complete, accurate and in accordance with the prescribed format. (Please see tables and sample illustrations). For uniformity and consistency, they can secure standard price tags/posters through their associations.

**(iii) Access to Government laboratory facilities to the grain millers, processors or packers in order to effectively comply with the grading requirement of grains standardization, especially if they do not have the needed grain laboratory facilities:** They can have their grain samples analyzed and graded at the DGF grain laboratories located in DGF HQ and regional and offices nationwide. They have the option also to go to third party, public or private grain laboratories to be duly accredited by the DGF. Likewise, grain retailers and other interested parties may also avail of such grain laboratory services, in ascertaining the quality of grains received from their suppliers.

**(iv) Significance of the national grains standards in the implementation of the innovative grains marketing programmes of DGF in the grains industry:** Given that the national grain standard adopted as, the common reference among market players, a rice farmer, for example, who decided to sell his produce to the DGF or to the rice miller or trader, will have no difficulty transacting business, or worry about being shortchanged. In fact, he would have the opportunity to optimize his profit because of the transparent and objective basis of the transaction based on mutually acceptable official standards. It is also possible to do business similar to an ATM-type banking transaction such that a farmer in Dinajpur who deposited his rice stocks in one of the DGF warehouses, will be able to withdraw the milled rice, or cash equivalent of the same from an DGF warehouse or branch office within Dhaka or elsewhere. In short, through national grains standards, the unhampered movement and trading of grain products across the entire country will be guaranteed and therefore beneficial to market players.

**(v) The role of grains industry stockholders and millers associations and retailers in the sustainable implementation of the grain standards:** Being the industry stockholder groups more directly concerned with the enforcement of the national grain standards among their ranks, these associations through their national and local leadership can

cooperate with the DGF in training their members regarding grains standardization. Moreover, these responsible associations can police their own ranks and impose disciplinary action against their erring members.

**(vi) Role of ordinary consumer, consumers groups, the mass media and educational institutions help in the advocacy on the grains standardization:** Knowing their basic rights as consumers and familiarizing themselves with the national grains standards, through active involvement in advocacy activities, ordinary consumers or consumers groups should always exercise vigilance against unfair trade practices in the grains market. The mass media, for its part, can educate the people regarding the importance of grains standardization, as well as, assist in exposing unfair trade practices which are in violation of the grains standards and other existing rules and regulations on grains business.

Educational institutions belonging to elementary, secondary and higher levels can help promote grains standards consciousness among students and professionals by including grains standardization in their health and nutrition courses and related subjects on consumerism.

**(vii) Revision or updating the national grain standards:** Grains standardization is a dynamic, continuing process. Mechanisms are in place so that such revision or updating of the national standards is undertaken in consultation with the grains industry and other concerned institutions or groups from both the public and private sectors. In fact, an important component of the grains standardization program is the grains standards revision. In the long term, these standards are ultimately geared toward harmonization with international standards that would help promote trade among countries under an emerging global economic order.

## 10. TRAINING

### TRAINING NEEDS FOR LABORATORY PERSONNEL AND INSPECTORS

The study group visited the DGF laboratory and LSDs in the headquarters and in the districts and noticed that there is little provision for any regular in-service training programs for the field staffs or technicians. Usually they learn different techniques of sampling and analysis from their working colleagues. Since new grading and inspection systems are being proposed, there should be regular training programs for newly appointed, as well as old, staff to upgrade their knowledge and skill to implement the proposed grading system efficiently.

### LABORATORY PROCEDURE FOR MILLED RICE ANALYSIS

#### Objectives

##### A. Project objective

To assess the quality of milled rice and pricing practices at the retail market in the rice production and consumption areas of the country as indicators of the functionality of the DGF Grains Standards.

##### B. Training objectives

- Become familiar with various laboratory equipment to be used for grain grading analysis
- To operate and maintain safety on the handling of various laboratory equipment during operation.
- To ensure ideal operating procedures of various laboratory equipment.
- To standardize the laboratory procedures for the analysis of samples
- To be able to collect representative samples for laboratory analysis.
- To be able to accomplish laboratory analysis of samples scientifically.

- To perform data analysis and make conclusion on laboratory sample analysis.
- To prepare report on grain analysis.

### GENERAL OVERVIEW OF LABORATORY PROCEDURE

The complete physical analysis of samples shall be performed at the Regional Laboratory of the selected areas using the Standard Procedure. Figure 1 shows a flowchart for milled rice analysis.

Physical characteristics such as head rice, broken, moisture content, defective grains and thousand grain mass (TGM) will be the basis for evaluating compliance to the national grains standards. Moisture content determination shall be done using a well-calibrated moisture tester.

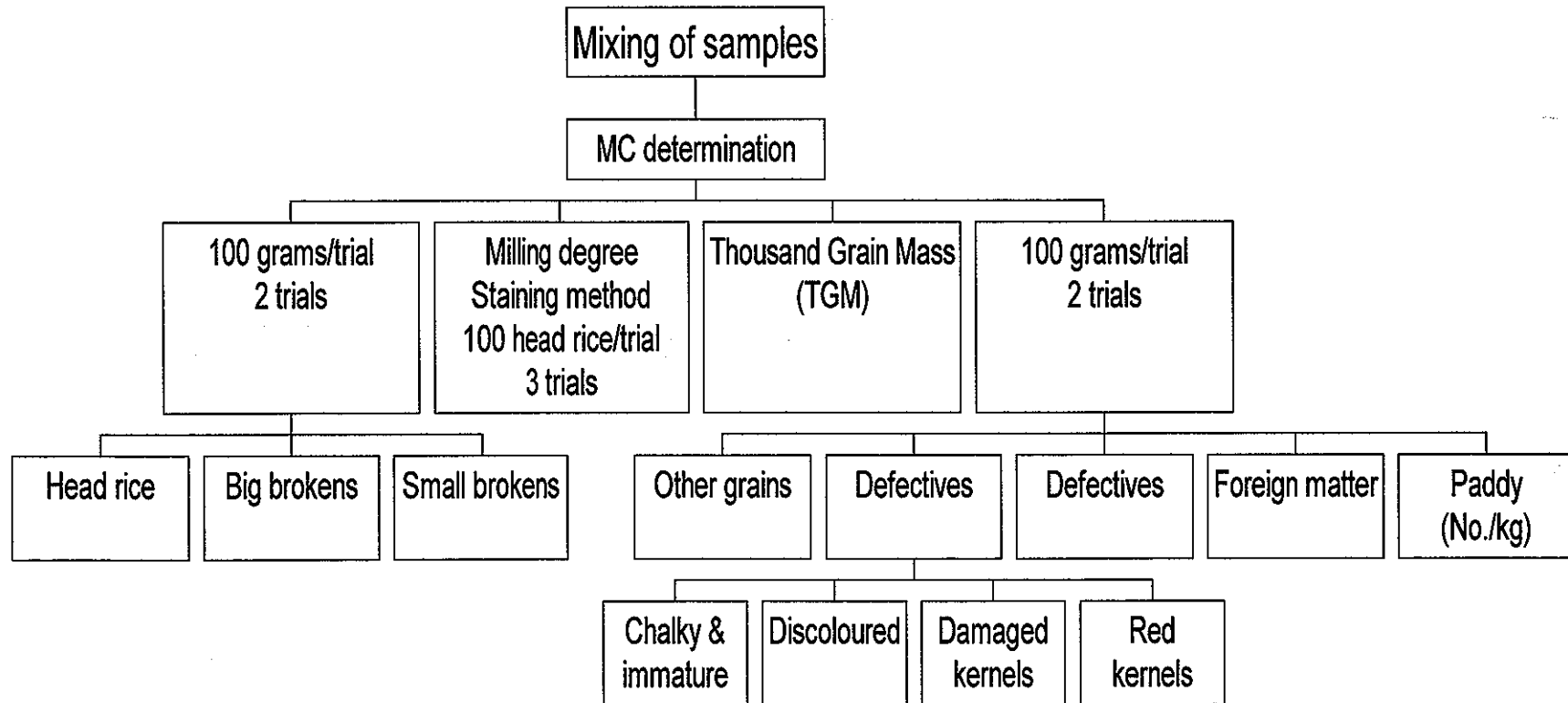
**Table 13 — Quality Standards for Milled Rice**

Quality Parameters	Parboiled		Atap (Raw)		Aromatic
	Fine	Coarse	Fine	Coarse	
Moisture (Max.) %	13.5	13.5	13.5	13.5	13.5
Big broken, (Max.) %	4.0	5.0	12.0	14.0	12.0
Small broken, (Max) %	3.0	3.0	4.0	4.0	4.0
Chalky and immature grain (Max.) %	nil	nil	1.0	2.0	nil
Admixture of varieties (Max.) %	1.0	2.0	1.0	2.0	3.0
Damaged, dead, discoloured and yellow kernels (Max.) %	1.0	1.0	2.0	3.0	2.0
Paddy (per kg) no. (Max.)	nil	nil	1.0	1.0	1.0
Foreign matter (Max.)%	0.25	0.25	1.0	2.0	nil
Red rice (max.) %	2.0	2.0	nil	nil	nil
Milling degree %	Well milled	Well milled	Well milled	Well milled	Well milled

Note: Well milled means 10% polished grain.

Figure 1

### Flow chart for milled rice analysis



## DETERMINATION OF HEAD RICE/ BROKENS/BREWERS

*Preparation of Working Samples*

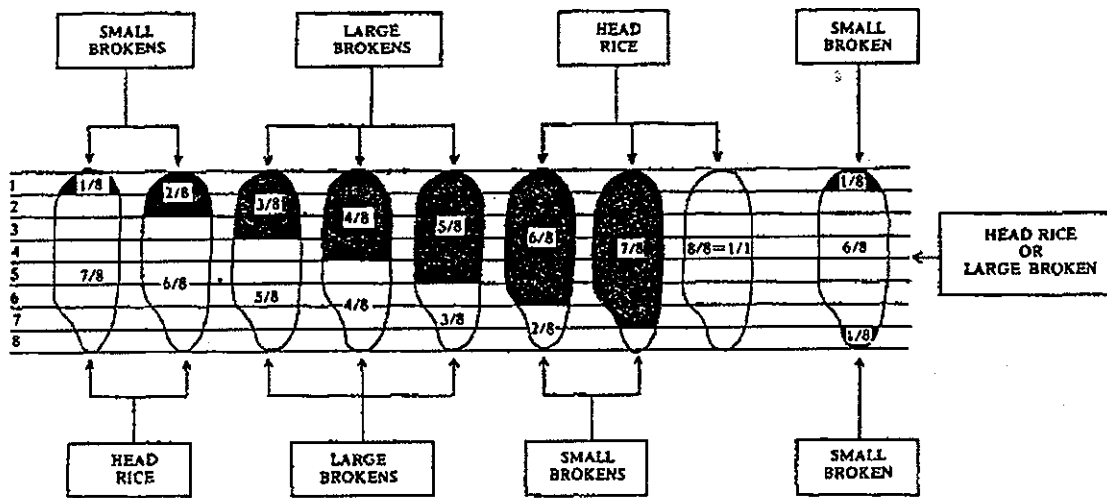
1. Pass the representative samples at least three (3) times through the mixer/divider to ensure homogeneity of the samples.
2. Prepare and weigh four (4) 100-g working samples for head rice and brokens analysis.

*Head Rice/Brokens/Brewers Determination*

1. Use the two (2) 100-g milled rice working samples prepared in A.1 and label them as T1 and T2.
2. Remove the brewers from the head rice using a 1.4 mm diameter sieve and separate the brokens from the head rice using indented plates to facilitate segregation. Check sorted components by manual separation to further classify the remaining mixtures.
  - 2.1. Head Rice is determined based strictly on its definition. The head rice shall be determined by the use of indented plates, perforated sieves and by manual separation.
    - 2.1.1 *Samples with kernels of uniform type* containing not more than 20% contrasting type.
      - a) Select at random ten (10) whole kernels from the mixed sample and measure the length of each kernel. Compute for the average length of the kernels.
      - b) Compute the 8/10th of the average length of the kernels which will be the minimum length for the head rice (refer to Fig. 2).
      - c) Prepare a reference line of measurement in determining the head rice of a sample using (b) as basis.
      - d) All kernels that are equal to, or more than, the length of the reference line are considered head rice.



Figure 2 — Classification of Milled Rice



2.1.2 *Samples of mixed type-* containing more than 20% contrasting type kernels.

- Select at random ten (10) whole kernels from the mixed sample and measure the length of each kernel. Compute for the average length of the kernels.
- Compute the 8/10th of the average length of the kernels, which will be the minimum length for the head rice.
- Prepare a reference line or measurement in determining the head rice of a sample using (b) as basis.
- All kernels that are equal to or more than the length of the reference line are considered head rice.

NOTE: All whole kernels irrespective of size shall be considered as head rice.

2.2. Brokens are determined based on the definitions for big, medium and small brokens.

2.2.1 *Sample with uniform type kernels*

- Use the average length of the kernels at 2.1.1. (a) as reference for computing the 5/10th and 2/10th length for big and medium brokens, respectively. Less than 2/10th in size are considered small brokens.

- b) Prepare a reference line or measurement using above (a) as the basis in determining the brokens of a sample.
- c) All kernels that are equal to or more than the length of the respective reference lines or measurements are considered big, medium or small, respectively.

#### 2.2.2 *Sample with mixed type kernels*

- a) Use the average length of the kernels at 2.1.2. (a) as reference for computing the 5/10th and 2/10th length for big and medium brokens, respectively. Likewise, the size of small brokens can be determined from the above.
- b) Repeat 2.2.1.(b) and (c).

2.3 Brokers are determined based strictly on its definition.

2.3.1 Gather brokers separated in 2.2.

### **Computation**

Weigh separate components and compute the individual percentage using the following equations.

$$\% \text{ Head rice} = \frac{\text{weight of head rice}}{\text{weight of working samples}} \times 100$$

$$\% \text{ Brokens} = \frac{\text{weight of brokens}}{\text{weight of working samples}} \times 100$$

$$\% \text{ Brewers} = \frac{\text{weight of brewers}}{\text{weight of working samples}} \times 100$$

Record data on the rice samples worksheet.

Equipment/ special tools required

1. Mixer/Divider
2. Indented plates
3. Grain caliper
4. Weighing balance

*Determination of Paddy Content, Foreign Matter and Chalky/Mature/Damaged/Discolored/Red-streaked/Red kernels*

A. Procedure

1. *Working sample* - the working sample prepared in A.2. will be used in the determination of chalky/immature/damaged kernels.
2. *Paddy, Foreign matter and chalky/immature/damaged determination* - use the remaining two (2) 100 g milled rice working samples prepared in head rice/brokens analysis and label it as T1 and T2.

B. Description

1. *No. of paddy/Kg*- the number of paddy shall be counted and computed in a per Kg basis.
2. *Foreign matter*- all matters other than rice grains, rice polishings and paddy such as weed seeds and other crops.
3. *Chalky kernel* - a grain in which half or more of the surface and cross section is white color of a chalk and is brittle. It is not a matured kernel.

NOTES:

- a) In case of a white-core rice grain, a grain with a chalky part larger than half of its plain area both on surface and cross-section shall be a chalky grain.
- b) In the case of a white-belly rice grain, a grain which has a chalky part longer than  $\frac{2}{3}$  of the whole grain length and longer than  $\frac{1}{3}$  of the width of grain shall be a chalky grain.
4. *Immature kernel*- insufficiently ripened grain whose pericarp contains chlorophyll.

NOTES:

- a) An underdeveloped kernel that is chalky with the appearance of light green or a tinge of green color or small and flat/slender kernel still chalky but not greenish.
- b) A grain that is dark green and is opaque shall be considered as immature kernel.
- c) A grain containing chlorophyll that is transparent and has fully matured (vitreous green kernel) shall be classified a sound grain.

5. *Damaged kernel*- a kernel that is distinctly damaged by insects, water, fungi and/or any other means.

## NOTES:

- a) Whole broken rice kernels that are sprouted shall be considered as damaged kernels. Spouted kernels are grains that show traces of budding and rooting.
  - b) Insect-bored kernels - whole and large broken kernels of rice that have been bored by insects are damaged kernels.
  - c) Contaminated or injured grains by insects, fungi, bacteria and heat which give visible damage on the surface of the grain - grayish, blackish or brownish spots or brownish spots or stains.
  - d) Kernels that were eaten by insects and are clean in appearance shall be considered as damaged kernels.
  - e) Rotten bud kernels - grains in which the germ part is colored and rotten.
  - f) Malformed grains such as notched-belly grains or twisted kernels in which the bran layer partly remains after milling due to irregular shape be considered as damaged kernels.
  - g) Other damaged kernels - whole and large broken kernels that are distinctly discolored or damaged from causes than those listed above shall be considered as damaged kernels.
6. *Discolored kernels* - undamaged kernels that have changed their natural color as a result of heating or other means.

## NOTES:

- a) Kernels that differ from its natural color such as yellowish to deep brown color on the surface of the kernel shall be considered as discolored kernel.
  - b) Even the slightest change in color is considered as discolored of yellow kernel
7. *Red streaked kernel* - whole or broken kernel with the smallest or shortest red streak on the surface of the kernel.
8. *Red kernel* - whole or broken kernel which has 25% or more of the surface red.

## NOTES:

In the incidence of multiple defects in a single kernel, it should be considered under the most strict quality parameters in terms of its limits based on the standards specification for milled rice.

Weigh separate components and compute the individual percentage using:

$$\% \text{ Foreign Matter} = \frac{\text{wt of immature kernel}}{\text{weight working samples}} \times 100$$

$$\% \text{ Chalky kernel} = \frac{\text{wt. of chalky kernel}}{\text{weight of working samples}} \times 100$$

$$\% \text{ Immature kernel} = \frac{\text{wt. of immature kernel}}{\text{weight of working samples}} \times 100$$

$$\% \text{ Damaged kernel} = \frac{\text{wt. of damaged kernel}}{\text{weight of working samples}} \times 100$$

$$\% \text{ Red streaked kernel} = \frac{\text{wt. of red streaked kernel}}{\text{weight of working samples}} \times 100$$

$$\% \text{ Red kernel} = \frac{\text{wt. of red kernel}}{\text{weight of working samples}} \times 100$$

Compute the number of paddy per kilogram milled rice using this equation:

$$\text{No. of paddy/Kg} = \frac{\text{no. of paddy}}{\text{weight of working samples(g)}} \times 1000\text{g/Kg}$$

Record data on the rice samples worksheet.

Equipment/special tools required

1. Weighing Balance

## DETERMINATION OF THOUSAND GRAIN MASS (TGM)

- (i) Reduce sample to obtain at least three replicates of approximately 50 g.
- (ii) Using the remainder of the sample, determine moisture content.
- (iii) Weigh each sub sample of approximately 50 g. accurately.
- (iv) Count the number of grains in each sub sample. Record total.
- (v) Calculate the thousand grain mass (TGM) as follows:

$$\text{TGM} = \frac{\text{Weight of Grain}}{\text{No. of Grain}} \times 1000$$

- (vi) Correct for moisture content to 14% as follows:

$$\frac{\text{TGM} \times (100 - \text{MC})}{86}$$

- (vii) Calculate mean TGM
- (viii) Determine % weight loss as follows:

$$\frac{\text{Baseline TGM (from initial sample)} - \text{Sample TGM}}{\text{Baseline TGM}} \times 100$$

## GRAIN APPEARANCE

## Determination of grain size and shape

1. Place 10 grains of milled rice sample on the logarithmic paper
2. Position each grain on the linear scale (1 line = 1 mm) to measure its length and breadth. An enlarger may facilitate the measurement.
3. Classify the grains to size and shape as per the following criteria.
  - a. Size classification

Scale	Grain type	Length (mm)
1	Very long (VL)	> 7.00
3	Long (L)	6.00-7.00
5	Medium (M)	5.50-6.90
7	Short (S)	<5.50

- b. Shape classification

Scale	Grain type	Length (mm)
-------	------------	-------------

1	Slender (S)	>3.00
3	Medium (M)	2.40-3.00
5	Bold (B)	2.00-2.39
9	Round (R)	< 2.00

### DETERMINATION OF MOISTURE CONTENT

The methods of determining the moisture content (MC) of rice grain can be divided into two broad categories: direct and indirect (Figure 1). Direct methods determine the water content by removing the moisture. For example, oven methods evaporate the moisture from the grain and determine the water content by the weight loss. Indirect methods, in contrast, require the measurement of an electrical property of the grain, either conductance or capacitance. The direct methods are considered to provide true measurement of moisture content. They are used to calibrate the more practical and faster indirect methods.

**Figure 3 — Classification of Grain Moisture Measurement Methods**

<b>MC Methods</b>	<b>Direct measurement</b>	<b>Chemical reaction</b> <b>Heating (oven)</b> <b>Distillation</b> <b>Infra red radiation</b> <b>Microwave radiation</b>
	<b>Indirect measurement</b>	<b>Resistance</b> <b>Capacitance</b> <b>Relative humidity</b>

#### **Direct Methods**

##### ***Air Oven Method***

1. Obtain three 250 gm paddy at random field samples.
2. Set the oven at 130<sup>0</sup>C.
3. Weigh three 10 gm paddy samples and place the samples inside the oven.
4. Measure the final weight of the samples after the 16 hrs.

5. Compute for the moisture content wet basis (MCWB)

$$\text{MCWB} = \frac{\text{Initial Weight} - \text{Final Weight}}{\text{Initial Weight}} \times 100$$

6. Compute the average MC.

### **Indirect Method**

#### **Moisture meter method**

Follow the procedure as specified in the manual of the Moisture Meter.

### **DETERMINATION OF MILLING DEGREE USING THE STAINING METHOD**

#### **A. Definition of terms**

1. *Alcohol-Alkali Bran Staining* - A method of determining milling degree which involves dipping the rice kernels in a 2% KOH-EtOH (Potassium Hydroxide-Ethyl Alcohol) solvent where the residual bran layers show up as brown patches or streaks against a background of light yellow endosperm.
2. *Alcohol-alkali staining solvent* - a solution of 2% KOH-EtOH in the volume ratio of 1:3.
3. *Milled rice* - kernels obtained after the removal of the hull and bran.
4. *Bran streaks* - longitudinal bran layers remaining in the dorsal grain grooves after milling.
5. *Degrees of milling* - the extent in which the bran layers and germ have been removed.

#### **B. Milling degree determination staining kit includes:**

- 15 pcs. sample plastic
- 6 pcs. Petri dish
- 1 pc Grai counter
- 1 pc. Wash bottle (1,000 ml.)
- 30 pcs.  $\frac{1}{4}$  size white bond paper contained in plastic envelope
- 2% KOH-EtOH staining solution contained in the wash bottle



### C. Preparation of staining solution

1. 2% KOH (Potassium Hydroxide)
2. Weigh 20 grams of KOH and dissolve in 1.0 liter of distilled water. Mix the 2% KOH with Ethyl Alcohol (EtOH) in the volume ratio of 1:3 shake well.

### D. Sampling

1. Gather the remaining milled rice samples at random from the 1 Kg source. Mix well.
2. Secure a five hundred (500) gram composite sample of the milled rice from D.1. Mix well.
3. Separate the head rice from the brokens manually or with the use of indented plates. Discard the brokens. Mix the head rice kernels thoroughly.
4. Prepare the working samples for 3 trials consisting of 100 pieces head rice per trial, manually or using a grain counter.

### E. Staining procedure

1. Place the kernels (100 pcs.) in a petri dish and pour 20 ml. of 2% KOH-EtOH solvent into the dish.
2. Cover the dish. Allow it to stand for 15-30 minutes.
3. Pour off the staining solution. Discard.
4. Transfer the stained head rice sample on a piece of white bond paper and air-dry for about 5 minutes.

### F. Determination of milling degree

1. Using either forceps, grain picker or your finger, separate the stained kernels with residual bran streaks whose length is at least 1/6 of the total length of this grain which is averaging in size of 6mm.  
Residual bran streaks are *highlighted distinctly* brown against a background of light yellow endosperm.
2. Count the separated kernels with bran streaks. The count corresponds to the percentage of kernels with bran streaks (BS) in a working sample.

$$\text{Number of kernels} = \% \text{ kernels with BS}$$

**G. Evaluation of results**

1. Enter data in the rice sample worksheet worksheet and get the average of three trials.
2. Refer to the NFA Standard Specification for Milled Rice for the corresponding milling degree.

**Table 14 — Standard Specifications for Milled Rice**

<b>Degree of Milling</b>	<b>% Kernels with BS</b>
Undermilled	More than 40%
Regular Milled	15%- 40%
Well Milled	Less than 15% (1%-14%)
Overmilled	%

**DETERMINATION OF PERCENTAGE OF INSECT DAMAGED GRAIN**

1. Take a random sample of 100-1000 grain.
2. Separate the bored grain manually.
3. Count the bored grain either manually or by using a grain counter.
4. Calculate the percentage of the damaged grain by using the following formula.

$$\frac{\text{Number of bored grain}}{\text{Total number of grain counted}} \times 100 = \% \text{ bored grain in sample}$$

This percentage is converted into percent weight loss by dividing by the conversion factor

- c. For milled rice the conversion factor is  $c = 2$ .

**DETERMINATION OF PERCENTAGE OF WEIGHT LOSS USING TGM METHOD**

1. Calculate mean thousand grain mass (TGM) of representative sample
2. Determine % weight loss as follows:

$$\frac{\text{Baseline TGM (from initial sample)} - \text{Sample TGM}}{\text{Baseline TGM}} \times 100$$

## 11. STRENGTHENING PHYSICAL FACILITIES FOR DGF LABORATORY

The existing laboratory equipments are very old and not adequate to perform all the tests. The following list of equipment/apparatus is proposed for the grading centres and DGF laboratories to upgrade the analytical capabilities.

### LIST OF LABORATORY EQUIPMENT

#### Component of a grading centre

- |                     |   |
|---------------------|---|
| 1. Moisture Meter   | - used in determination of moisture content                 |
| 2. Testing Husker   | - used to remove the outer covering (husk) of grains        |
| 3. Testing Mill     | - used in evaluating milling characteristics of paddy       |
| 4. Aspirator        | - to separate impurities and other light matters            |
| 5. Trieur Cylinder  | - to separate heads or whole grains from the broken grains  |
| 6. Drier            | - to dry wet samples of paddy before actual quality testing |
| 7. Thickness Grader | - to separate immature grains and other undersized kernels  |
| 8. Sample Divider   | - to properly divide test samples and other test materials  |
| 9. Balance          | - for weighing test samples and other materials             |
| 10. Sample Probe    | - used to draw samples from bagged grain                    |
| 11. Seed counter    | - to count specific amount/number of samples                |

#### List of equipment/apparatus for a primary laboratory

1. Air oven
2. Sample divider
3. Enameled plates round
4. Sample scoops
5. Portable balance with weight box

6. Analytical balance
7. Moisture meter
8. Glass slab
9. Tube sampler
10. Magnifying glass
11. Hot plate or electric heater
12. Aluminum pot with cover
13. Polythene sample bags (different size)
14. Sample slips
15. Cloth sample bags
16. Thermometers
17. Slide calipers
18. Tongs
19. Forceps
20. Measuring cylinders
21. Measuring flasks
22. Desiccators
23. Aluminum moisture dishes
24. Sample pan
25. Glass jars
26. Heat sealer
27. Specimen tube
28. Grinding mill
29. Test sieves of different sizes
30. Petri dishes

## 12. STRENGTHENING PHYSICAL FACILITIES FOR DGF LIBRARY

At present there is no librarian at the DGF although a small library is being maintained with mostly local Bangla books. To start with, the following technical books may be procured for the laboratory and technical staffs.

### LIST OF BOOKS

Sl. No.	Title	Author
1	Food Science	Potter and Hotchkiss
2	Rice, volume 1	Lub, B. S.
3	Rice, volume 2	Lub., B. S.
4	The Chemistry and Technology of Cereals as Food and Feed	Matz, S. A.
5	Principles of Human Nutrition	Eastwood, M.
6	Food Analysis. General Techniques, Additives, Contaminants & Composition	Food & Agric Organization
7	Modern Methods of Food Analysis	Stewart, Kent K.
8	Food Chemistry	Clark, Nigel
9	Official Methods of Analysis Vol. 1	Assoc. of Official Analytical Chemists
10	Official Methods of Analysis Vol. 2	Assoc. of Official Analytical Chemists
11	Official Methods of Analysis Vol. 3	Assoc. of Official Analytical Chemists
12	FAO/WHO Methods of Analysis for Edible Fats and Oils	Food & Agric. Organization

### 13. CONCLUSIONS

1. Since the average moisture content from DGFs and milled rice samples were found to be less than 13.5%, therefore, a reduction in moisture from 14% to 13.5% is suggested.
2. The big broken percentage for coarse (Boro and Aman), fine and aromatic rice on average were 2.55% & 2.44%, 3.88% and 7.77%, respectively. This indicates that the broken percentage was gradually higher from coarse to fine and to aromatic. Therefore, a maximum of 5% big broken may be suggested for coarse grain. Although, results from DGF samples indicate a higher percentage of small broken (5.79%) compared to the existing limit of 3%; but the percentage of small broken from the mills was about 3%. So, the allowable limit of small broken will remain the same as before (3%).
3. The maximum limit of admixture of other varieties should be changed from 8 to 2%; because the average results from the collected samples of LSDs and mills was about 1.2%.
4. Red rice parameters should be included in quality assessments, because red rice was found in most of the collected parboiled samples and it ranged from 1 to 2%. Other quality parameters will remain the same as before.
5. In order to classify varieties distinctly, the size, shape and breadth, in particular, of rice kernels have been used. The coarse group includes varieties whose breadth is more than 2.00 mm. The medium group includes varieties whose breadth ranges from 1.70 to 2.00 mm. The fine group includes varieties whose breadth is less than 1.70 mm. The aromatic group includes varieties that have aroma. The breadth of these varieties ranges from 1.55 to 1.74 mm.
6. Storage duration normally ranges from 6-15 months. Insects are not considered a serious problem in most LSDs because the grain storage period is short for insect population built-up.
7. In general, existing milling practices are not capable to produce export quality rice for the international market. However, there are already some millers producing export quality rice at a limited scale. It is a positive indication that export quality rice can be produced if proper management and marketing is assured.

#### **14. RECOMMENDATIONS, STRATEGY AND POLICY IMPLICATIONS**

1. In order to provide incentives to the quality of products a differential quality grading system is to be formulated with an incremental pricing system.
2. Standard quality criteria for paddy and milled rice need to be enforced for not only DGF, procurement but also for every level of paddy and milled rice marketing.
3. Grading improvement on rice is not possible within a short period. Therefore a long term program of 5-10 yrs may be launched and improvement to be measured on some pre-determined indicators.
4. Appropriate rubber roll shellers should be designed or imported and installed at an existing Engleberg rice mill for obtaining an acceptable quality of rice and its by-products and to discourage further installation of Engleberg rice mills.
5. A paddy and milled rice grading improvement program is to be implemented through establishing a working group on grading at the district level.
6. Procurement of grain must be started progressively at the beginning of harvesting time and must be put into safe storage within a short time to avoid loss because infestation started since maturing the crop.

## REFERENCES

- Ali Hashifah Md and Rohani Md Yon 1985, Paddy and rice grading systems in Malaysia. Rice Grading, Inspection and Analysis. Regional Field workshop on rice grading, inspection, and analysis. Lahore and Karachi, Pakistan March 11-18, 1985.
- Baqui M A ; M E Harun, D Jones and R. Stingfellow, 1996-97. The export potential of traditional varieties of rice from Bangladesh , report on field work in Bangladesh, Bangladesh Rice Research Institute and Natural Resources Institute, United Kingdom.
- Baqui M. A.; M A K Miah and A Ahmed, 1994. Processing technologies of rice in Bangladesh, Paper presented in the National workshop on Post Harvest Processing, BARC, Dhaka, June, 1994.
- Baqui, BRRI 2000. Personnel Communication.
- FAO. 1997. Statistical data bases for primary agricultural production. Internet Website, <http://www.fao.org/>
- Garg, O. P. and Agarwal, N. S. 1966. Bulletin, Grain Technology, Harpur, UP-4, India.
- IFPRI, 1992, News letter of the International Food Policy research Institute, Bangladesh Food Policy Project. House No. 9A, Road No. 15 (New), Dhanmandi, R/A, Dhaka 1209.
- Malik, Miah Abdul 1985, Quality Assessment of Exportable varieties of rice and Procurement procedures in Pakistan. Rice Grading, Inspection and Analysis. Regional Field workshop on rice grading, inspection, and analysis. Lahore and Karachi, Pakistan March 11-18, 1985.
- Pandey Prabhat Chandra 1985, Paddy/rice sampling, grading and analysis methods adopted in Nepal. Rice Grading, Inspection and Analysis. Regional Field workshop on rice grading, inspection, and analysis. Lahore and Karachi, Pakistan March 11-18, 1985.
- Rahman, N. Anas and M. Sakrani 1985, Quality standard and price formation in Procurement of rice in Indonesia. Rice Grading, Inspection and Analysis. Regional Field workshop on rice grading, inspection, and analysis. Lahore and Karachi, Pakistan March 11-18, 1985.
- Romulo Jr. R. Gervacio 1985, Grain Grading project in the Philippines. Rice Grading, Inspection and Analysis. Regional Field workshop on rice grading, inspection, and analysis. Lahore and Karachi, Pakistan March 11-18, 1985.
- San Nguyen Tien 1985, Status of Quality assessment in vietnam. Rice Grading, Inspection and Analysis. Regional Field workshop on rice grading, inspection, and analysis. Lahore and Karachi, Pakistan March 11-18, 1985.
- Shidhu, D. S. 1998. Marketing of rice and wheat in India (Revised). A consultancy report (World Bank). Punjab Agricultural University, Ludhiana, India.



Swetman, T. 1996-97. The export potential of traditional rice varieties from Bangladesh. Final Technical Report Project R6689. Department for International Development (DFID). Crop Postharvest Programme, Natural Resources Institute (IRRI). The Univ. of Greenwich, UK.

Tun, U Than 1985, Paddy/rice grades and standards in Burma (Myanmar). Rice Grading, Inspection and Analysis. Regional Field workshop on rice grading, inspection, and analysis. Lahore and Karachi, Pakistan March 11-18, 1985.

Umeno Yoshitsugu 1985, Inspection system, procurement procedures and the relation between inspection grades and procurement prices in Japan. Rice Grading, Inspection and Analysis. Regional Field workshop on rice grading, inspection, and analysis. Lahore and Karachi, Pakistan March 11-18, 1985.

United States Standards for Rice. 2000.

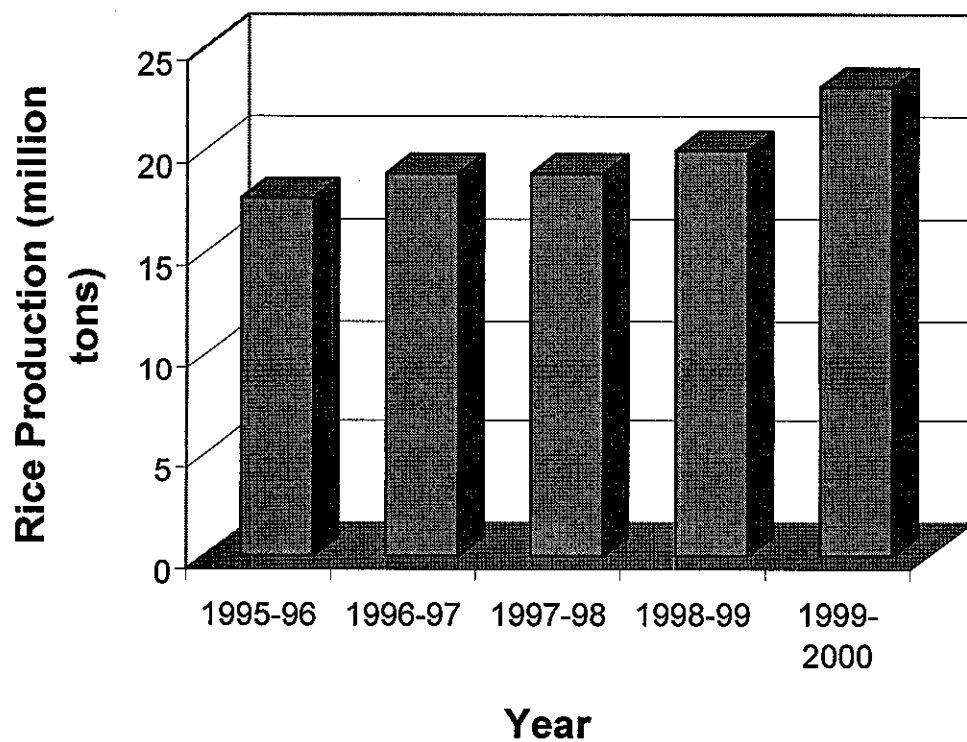
<http://www.usda.gov/gipsa/strulreg/standard/rice.htm>

Vaidhyakarn Sthaphorn 1985, Rice Breeding programme in Thailand. Rice Grading, Inspection and Analysis. Regional Field workshop on rice grading, inspection, and analysis. Lahore and Karachi, Pakistan March 11-18, 1985.

Zhiying Fang, 1985, Rice grading methods, marketing and Pricing policy in China. Rice Grading, Inspection and Analysis. Regional Field workshop on rice grading, inspection, and analysis. Lahore and Karachi, Pakistan March 11-18, 1985.

## APPENDICES

Appendix 2.1.1 — Milled Rice Production in Bangladesh (1995-2000)



**Appendix 2.1.2 — Bangladesh Pure Food Rule, 1967**

(for food grains, cereals and their products)

**Food Grains:** Shall include rice, wheat, gram (chick peas) barley, oats, maize, jawar, bajra. Food grains for human consumption shall be clean, dry and free from molds. It shall be free from damage (by insect or otherwise) bad smell, discolouration and admixture with deleterious and toxic materials. Food grains shall conform to the following standards:

- (a) **Colour** - The grains shall have its normal colour as far as possible but slight discolouration shall not make it unfit for use if it has not developed any unpleasant smell or taste:
- (b) **Smell** - It shall be free from persistent bad smell.
- (c) **Taste** - It shall not possess any taste uncharacteristic of the grain.
- (d) **Foreign matter** - It includes sand, gravel, dirt, stones, pebbles, straw, stems, chaff, cockles, oilseeds and other non poisonous seeds. It shall not exceed 3 percent by weight.
- (e) **Damaged grain** - Grains which are damaged, touched or moldy or shrivelled shall not exceed a total of 10

percent and the moldy grain, after superficial cleaning, shall not be more than 1.5 percent.

(f) *Insect* - Damaged grain shall not exceed the limit of 5 percent.

(g) *Sound grain* - Notwithstanding the permissible limits stated in "Foreign Matter" and "Moisture Content", the percentae of normal and sound grains shall in no case be less than 85 percent of the total, including the small percentage of "Foreign food grains".

(h) *Moisture Content* - The moisture content at any time of the year irrespective of climate, shall not exceed 13 percent.

**Appendix 2.1.3 — Bangladesh Standard Specification for Grades on Milled Rice (First Revision, BDS 592 : 1981, BSTI)**

In the preparation of the standards, the committee took into consideration the views of the rice millers, technologists, research workers and the Government and Semi Government Departments as well as the recommendations of the Technical Committees of the Inter-Ministerial Working group on rice and wheat grading.

**1. Terminology**

- 1.1 **Milled rice:** Paddy from which the husk has been removed and separated and the germ and layers of bran wholly or partly removed and separated from the kernels.
- 1.2 **Kernel:** Edible portion of the grain.
- 1.3 **Germ:** Embryo situated at one end of the grain.
- 1.4 **Chalky kernel:** Kernels whole or broken, one half or more of the surface of which is white like the colour of chalk.
- 1.5 **Parboiled rice:** Rice that, before milling, has received hydrothermal treatment (soaking and steaming) to gelatinize all or part of the grain's starch and is then dried.
- 1.6 **White rice (Atap):** Rice that has not received hydrothermal treatment.
- 1.7 **Moisture:** This is the water content of the grain computed on a wet basis, as received.
- 1.8 **Head rice (Whole kernel):** The head rice or whole kernels shall be kernels of milled rice of not less than  $3/4^{\text{th}}$  of the length of the grain. The head rice shall be determined by the use of intended places, performed sieves or head picking.
- 1.9 **Big broken:** Pieces of kernels having a length of  $1/2$  or more of the average length of the unbroken kernels.

- 1.10 **Small broken:** Pieces of kernels not exceeding the 1/4 of the average length, but below 1/2 of the unbroken kernels of the variety concerned.
- 1.11 **Other rice variety:** Head rice and broken other than the variety concerned.
- 1.12 **Damaged kernels:** Kernels, whole or broken, that are distinctly damaged by insects, water, fungi or any other means which materially affect the quality of the grains.
- 1.13 **Immatured kernel:** Kernels, whole or broken, that are unripe and under developed.
- 1.14 **Discoloured grain:** Grain that has lost its natural colour.
- 1.15 **Foreign material:** All matter other than rice kernels, rice polishing or paddy.
- 1.16 **Well milled:** Is the removal of bran entirely to the extent that the rice kernel has a beautiful appearance.
- 1.17 **Milled rice shall conform to any of the following degrees of milling:**
- a) **Husked rice:** Paddy from which only the husk has been removed. Also known as brown rice, cargo rice, hulled rice, loonzain rice, and anramato rice.
  - b) **Undermilled rice:** Paddy from which the husk, a part of the germ and all or part of the outer bran layers, but not the inner bran layers, have been removed.
  - c) **Reasonably well milled rice (Medium milled rice):** Paddy from which the husk, the germ (part of the germ in the case of round rice), the outer grain layers and the greater part of inner bran layers have been removed, but parts of the lengthwise streaks of the bran layers may still be present on not more than 80 percent of the kernels.
  - d) **Well milled rice:** Paddy from which the husk, the germ (part of the germ in the case of round rice), the outer bran layers and the greater part of the inner bran layers have been removed, but parts of the lengthwise streaks of the bran layers may still be present on not more than 10 percent of the kernels.

- e) **Extra well milled rice:** Paddy from which the husk, the germ (part of the germ in the case of round rice) and the bran layers have been completely removed.

**2. Grades**

- 2.1** Each class (see 3.1) of milled rice shall be divided into four distinct grades on the basis of the composition and quality factors as specified in Tables 2.1.4 and 2.1.5.

Note: Reproduced from Bangladesh Standard Specification for grades on milled rice (First revised/edition, 1987).

Appendix Table 2.1.4 — White Rice

Item No.	Grading factor	Grading requirements			
		Grade-I	Grade-II	Grade-III	Grade-IV
1.	Moisture, percent by mass (max.)	14.0	14.0	14.0	14.0
2.	Head rice, percent (min.)	90.0	85.0	75.0	68.0
3.	Big brokens, percent (max.)	8.0	12.0	20.0	25.0
4.	Broken and small brokens, percent (max.)	2.0	3.0	5.0	7.0
5.	Damaged grain, percent (max.)	0.5	1.0	2.0	3.0
6.	Contrasting varieties, percent, (max.)	2.0	5.0	10.0	15.0
7.	Chalky/immatured grain percent, (max.)	1.0	2.0	3.0	4.0
8.	Paddy (grain per 1000 gm.)	1.0	2.0	3.0	4.0
9.	Foreign matters, percent, (max.)	0.2	0.3	0.5	1
10.	Degree of milling	Extra well milled	Well milled	Reasonably milled	Under milled

Notes: (1) Any rice not falling in any of the above grades shall be considered as sub-standard.  
 (2) The grade requirements are expressed in percentage except for paddy seeds.  
 Source: BSTI 1981.

Appendix Table 2.1.5 — Parboiled Rice

Item No.	Grading factor	Grading requirements			
		Grade-I	Grade-II	Grade-III	Grade-IV
1.	Moisture, percent by mass (max.)	14.0	14.0	14.0	14.0
2.	Head rice, percent (min.)	95.0	90.0	85.0	80.0
3.	Big brokens, percent (max.)	4.0	8.0	12.0	16.0
4.	Brokens and small brokens, percent (min.)	1.0	2.0	3.0	4.0
5.	Damaged grain, percent (max.)	0.5	1.0	2.0	3.0
6.	Contrasting varieties, percent (max.)	2.0	5.0	10.0	15.0
7.	Paddy (grain per 1000 gm.)	1.0	2.0	3.0	4.0
8.	Foreign matters, percent (max.)	0.3	0.4	0.5	1.0
9.	Degree of milling	Extra well milled	Well milled	Reasonably well milled	Under milled

Notes: (1) Any rice not falling in any of the above grades shall be considered as sub-standard.  
 (2) The grade requirements are expressed in percentage except for paddy seed.



### 3. Contaminants

- 3.1 Pesticides residues:** Milled rice shall be prepared with special care under good manufacturing practices, so that residues of those pesticides that may be required in the production storage of processing do not remain, or if technically unavoidable, are reduced to the maximum extent possible. Residue limits for pesticides shall be those recommended by Codex Alimentarius Commission.
- 3.2 Other contaminants:** Milled rice shall be free from harmful contaminants especially toxins and colouring material.

### 4. Hygiene

- 4.1** To the extent possible in good manufacturing practice, milled rice shall be free from objectionable matter.
- 4.2** When tested by appropriate methods of sampling and analysis, milled rice:
- i) shall not contain any substances originated from micro-organisms in amounts which may represent a hazard to health, and
  - ii) shall not contain any other poisonous or deleterious substances in amounts which may represent a hazard to health.
- 4.3** Milled rice should be prepared, packed and stored under sanitary conditions as presented in BDS 822: 1975.

### 5. Packing and marking

- 5.1 Packing:** Milled rice shall be packed in containers that will safeguard the hygiene and other qualities of the food.
- 5.1.1** The containers including packing materials shall be made of only substances that are safe and suitable for their intended use. Where the Codex Alimentarius Commission has established a standard for any substance used as packing material, the standard shall apply.
- 5.2 Marking:** Each bag shall be suitably marked so as to give the following information if agreed between the buyer and the seller:
- a) Name and grade of the material;
  - b) Name and address of the miller;
  - c) Batch or code number;
  - d) Net mass.
- 5.2.1** All marking shall be applied on the bags in such a manner that the dye or ink does not penetrate into the material.

**Appendix Table 2.1.6 — Procurement Criteria for Milled Rice**

People's Republic of Bangladesh  
Directorate General of Food  
Procurement Section

**Internal T. Aman and Boro Procurement Criteria, 2000-2001**

Quality Parameters	Aman Parboiled	Raw (Atap)	Boro Parboiled
1. Moisture content by mass (Max.) percent	14	14	14
2. Big broken (Max.) percent	8	12	8
3. Small broken (Max.) percent	4	8	2
4. Admixture of other varieties	8	8	8
5. Damaged grain, (Max.) percent	1	1	1
6. Dead & Immature grain (Max.) percent	1	1	1
7. Discoloured grain (Max.) percent	1.5	1.5	1
8. Chalky grain (Max.) percent	-	1	-
9. Paddy (per kg) No.	1	2	1
10. Foreign matter (Max.) percent	0.3	0.3	0.3
11. Milling degree	Well milled	Well milled	Well milled
12. Under boiled percent	1	NA	1

Source: Memo No. (i) Procurement – IRRI/Boro (4)/2000/253 (1262) dt. 18.4.2000

(ii) Procurement – Aman (12)/2000/930(1262) dt. 30.11.2000

**6. Sizes and shape of milled rice:**

**6.1** Milled rice shall be of the following three classes according to grain size:

- a) Long grain: Rice with 80 percent or more of whole milled kernels having a length of 6.0 mm and above.
- b) Medium grain: Rice with 80 percent or more of whole milled kernels having a length of 5.0 mm to 5.99 mm.
- c) Short grain: Rice with 80 percent or more of whole milled kernels having a length of less than 5.0 mm.

**6.2** Rice shall also be of the following three types of shape:

- a) Fine (Slender): Rice with whole milled kernels having length/breadth ratio 2.8 and above.
- b) Medium (Bold): Rice with whole milled kernels having length/breadth ratio between 2.1 and 2.7.
- c) Course (Round): rice with whole milled kernels having length/breadth ratio less than 2.1.

Appendix 2.2.1 — Standard Specifications for Milled Rice of India (National Grade)

Appendix Table 4a — Specifications for Rice – Fair-Average Quality of India (1972)

Grading factor	Type of rice	Slender group (long, short and medium)		Bold group (long, short and medium)		Rate at which cuts shall be imposed for ad-mixtures or impurities exceeding tolerance limits specified in column 2 and 4
		Tolerance limit (%)	Rejection limit (%)	Tolerance limit (%)	Rejection limit (%)	
1. Broken	Raw: <math><1/4^{\text{th}}\text{ to }>3/4^{\text{th}}</math>	15.0	20.0	22.0	30.0	T. L. to R. L. at $1/4^{\text{th}}$ value. Beyond R. L. at $1/2$ value.
	<math><1/8^{\text{th}}\text{ to }>1/4^{\text{th}}</math>	3.0	5.0	3.0	5.0	
	Parboil: <math><1/4^{\text{th}}\text{ to }>3/4^{\text{th}}</math>	10.0	15.0	15.0	20.0	
	<math><1/8^{\text{th}}\text{ to }>1/4^{\text{th}}</math>	3.0	5.0	3.0	5.0	
2. Foreign matter : (a) Inorganic (b) Organic	Raw	0.2	0.5	0.2	0.5	
	Boiled	0.1	0.5	0.1	0.5	
	Raw	0.5	1.0	1.0	1.5	
	Boiled	0.25	1.0	1.0	1.5	
3. Damaged grains	Raw	2.0	4.0	2.0	5.0	T. L. to R. L. at $1/2$ value. Beyond R. L. at full value.
	Boiled	2.0	4.0	3.0	5.0	
4. Chalky grains	Raw	4.0	8.0	8.0	12.0	T. L. to R. L. at $1/8^{\text{th}}$ value. Beyond R. L. at $1/4^{\text{th}}$ value.
	Boiled	-	-	-	-	
5. Discoloured grains	Raw	2.0	4.0	2.0	4.0	T. L. to R. L. at $1/4^{\text{th}}$ value. Beyond R. L. at $1/2$ value.
	Boiled	3.0	5.0	5.0	10.0	
6. Red grains	Raw	3.0	6.0	6.0	10.0	T. L. to R. L. at $1/4^{\text{th}}$ value. Beyond R. L. at $1/2$ value.
	Boiled	3.0	6.0	6.0	10.0	
7. Ad-mixture of inferior varieties	Raw	10.0	20.0	15.0	25.0	T. L. to R. L. at $1/4^{\text{th}}$ value. Stocks containing ad-mixture rejection limit to be down-graded.
	Boiled	10.0	20.0	15.0	25.0	
8. De-husked grains	Raw	10.0	20.0	10.0	20.0	T. L. to R. L. at $1/8^{\text{th}}$ value. Beyond R. L. at $1/4^{\text{th}}$ value.
	Boiled	10.0	20.0	10.0	20.0	
9. Moisture	Raw	14.0	16.0	14.0	16.0	T. L. to R. L. at full value. Beyond R. L. at $1 1/2$ value
	Boiled	15.0	16.0	15.0	16.0	

Notes: T. L. = Tolerance limit.

R. L = Rejection limit.

(1) The definition of the above refractions and method of analysis are to be followed as given in the Bureau of Indian Standards' "Method of Analysis in Foodgrains," Nos. IS: 4333 (Part I) 1967 and IS: 4333 (Part II) 1967.

(2) The method of sampling is to be followed as given in the Bureau of Indian Standards' "Method of Sampling of Cereals and Pulses," No. IS: 2814-1964

(3) Specifications for superior Basmati in force are to continue.

(4) If brokens less than "1/8<sup>th</sup> to 1/4<sup>th</sup>" size are less than 3%, quantitative benefit may be given against brokens of the size of "over 1/4<sup>th</sup> to below 3/4<sup>th</sup>" within the overall tolerance limits. Similarly, if such brokens are 3/4<sup>th</sup> within the overall tolerance limits. Similarly, if such broken less than 5%, rejection limits of brokens of the size of 'over 1/4<sup>th</sup> to below 3/4<sup>th</sup> will increase correspondingly within the overall rejection limits.

(5) Brokens less than 1/8<sup>th</sup> of the size of full kernel will be treated as foreign matter.

Source: Handling and storage of food grain, the Food Corporation of India, Indian Council of Agricultural Research, New Delhi

Appendix Table 2.2.2 — Schedule of Specifications for Rice, India, 1997-98

Sl. No.	Constituents	Maximum limits (%)	
		Grade 'A'	Common
1. Broken:	Raw	24.0	30.0
	Parboiled	15.0	17.0
2.	Foreign matter Raw/Parboiled	0.5	0.5
3. Damaged/slightly damaged:	Raw	3.5	3.5
	Parboiled	4.0	4.0
4. Discoloured grains:	Raw	3.5	3.5
	Parboiled	8.0	8.0
5.	Chalky graings:	6.0	6.0
6. Red grains:	Raw	3.0	3.0
	Parboiled	4.0	4.0
7.	Admixture of lower classes:	14.0	-
8.	Dehusked grains:	10.0	10.0
9.	Moisture content:	14.0	14.0

## Notes:

1. The method of sampling to be followed is given as the Bureau of Indian Standards' "Method of Sampling of Cereals and Pulses " No. LS 2814-1964 as comended form time to time.
2. Broken less than 1/8th of the size of full kernels will he treated as organic foreign matter. With the overall limit for broken, the small broken of the size of 1/8th to 1/4th shall not exceed 1.0%. For determination of the size of the broken's average, length of the principal class of rice should be taken into account.
3. Inorganic foreign matter should not exceed 0.5 in lot if it in more, the stocks should be cleaned and brought within the limit. Kernels or pieces of kernels having mud sticking on the surface of rice shall be treated as inorganic foreign matter.
4. In the case of rice prepared by pressure parboiling technique, it will be ensured that the correct process of parboiling is adopted i.e. pressure applied, the time for which pressure is applied, proper gelatinisation, seration and drying before milling are adequate so and the colour and cooking time of parboiled rice are good and free from encrustation of the grains.

Source: Sidhu, D. S. 1998

### Appendix 2.3.1 — Quality Standards of Nepalese Rice

In order to ensure smooth procurement operation, rice can be purchased in addition to the maximum limit prescribed in the single grade specifications in respect of the following items of refractions:

- (i) Damaged/slightly damaged grains: Damaged/slightly damaged grains are accepted up to 3% only in respect of raw rice. There is no cut up to 2%. Between 2% to 3% the cut is applicable at the rate of 1/2 value (half value cut).
- (ii) Small brokens: The small brokens percentage, without any change in the percentage of overall brokens, is procured up to a maximum of 2%. Up to 1% there is no cut. Between 1% to 2%, the value cut is applicable at the rate of 1/2 value (half value cut).
- (iii) Dehusked grains: The dehusked grains are accepted up to 13% for all groups of rice with value cut. There is no cut up to 10%. Above 10% to 13% cut is applicable at the rate of 1/4th value (one-fourth value cut).
- (iv) Moisture content: The rice is procured up to maximum of 15% moisture content with value cuts (raw and par-boiled). There is no cut up to 14%. Between 14% and 15%, cut is applicable at the rate of full value.

Appendix Table 2.3.2 — Parboiled Rice

Factors	Tolerance limit %	Rejection limit %	Price reduction
a. Moisture	14.5	14.5	-
b. Foreign matter	0.5	0.5	
c. Broken	16.00	20.00	½ of the value
d. Damaged	3.00	5.00	Full value
e. Discoloured	4.00	8.00	½ of the value
f. Red and ungelatinised	5.00	7.00	½ of the value
<b>Raw Rice</b>			
a. Moisture	14.00	14.00	
b. Foreign matter	0.5	0.5	
c. Brokens	25.0	33.00	½ of the value
d. Damaged	3.00	3.00	-
e. Discoloured	3.00	4.00	½ of the value
f. Red and chalky	7.00	8.00	½ of the value

Note: In fine rice the mixture of coarse rice should not be more than 10%. While procuring rice grain quality standard upto rejection limits is accepted with price reduction.

Source: Panday, 1985

## Appendix 2.4 — Standard Specifications for Milled Rice of Burma (Myanmar)

### Appendix 2.4.1 — Types of Burmese Rice

#### I. The quality of Burmese (Myanmar) Rice is classified according to the types of rice:

- (1) White Rice
  - (a) Ngasein White rice is milled from Ngasein type of paddy.
  - (b) Emata White Rice is milled from Emata type of paddy.
  - (c) Zeera White Rice is milled from Letywezin type of paddy.
- (2) Boiled rice
  - (a) Milchar No. 1, 8% broken is milled from Ngasein type of paddy.
  - (b) Ngasein Full Boiled 12% broken is milled from Ngasein type of paddy.
  - (c) Long Boiled 10% broken is milled from Emata type of paddy.
- (3) Loonzain Rice
 

Ngasein/Emata/Zeera Loonzin are milled from Ngasein/Emata/Zeera types of paddy respectively.
- (4) Broken Rice
 

There are various different grades of Broken Rice.

  - (a) A Extra; A1 and Extra Mixed, A1, A2, A1 & 2 Mixed, A2, 3 & 4 Mixed are produced from millings of super qualities of all varieties.
  - (b) B Extra; B1 & Extra Mixed; B1, B2; B1 & 2 Mixed; and B2, 3 & 4 Mixed are produced from millings of Ngasein and Meedon Burma 15% & 25% and also from any millings of Emata and Zeera.
  - (c) Ordinary No. 2, 3, and Mixed is produced from Ngasein SMS and Meedone Bazaar Quality.
  - (d) Boiled Broken Rice is produced from milling of Milchar 2, Full boiled Rice and Long Boiled rice.
  - (e) Cargo Broken rice is produced from millings of Loonzain.

#### II. Definitions

- (1) Whole kernel
 

The size of whole kernel is 0.80 and above.
- (2) Quality
 

The rice shall be of fair average quality (FAQ) of the season, and shall be in sound and merchantable condition.
- (3) Red streaks
 

Red streaks mentioned in the list are the number of red streaks counted on one face of the kernels.
- (4) Damaged grain
 

Damaged grain is defined as head rice damaged by water, heat, insects, fungi, bacteria or by any other means i.e. head rice bored by insects, coloured into black or other colour in one or



more spots or areas, or stained or materially damaged and includes yellow grains, immature grains, mildewed grains, deteriorated grains, floor-damaged grains, weevilled grains, and chalky kernel.

- (5) **Foreign matter** Foreign matter is defined as all matters other than head rice, big brokens and brokens and includes dust, husk, weevilled webs (excluding rice and brokens), straw, dead insects, sand and dirt, seeds of other plants and points.
- (6) **Chalky kernel** Chalky kernel means a kernel with half or more of the surface area of which is white like the colour of chalk.
- (7) **Big Brokens and Brokens** Big brokens and brokens are taken specified according to the specifications and the sizes for each grade of rice are as mentioned in the respective specifications.

(N.B. In the white and boiled rice, any excess of big brokens over the respective specified allowances shall be treated as broken up to respective specified allowances.)

III. Appendix Table 2.4.1.1 — Specifications of Burmese (Myanmar) White Rice

Sl. No.	Quality	Milling standard	Separation			Size of big Bkns	Size of Bkns	Foreign grain (%)
			Head rice %	Big Bkns %	Bkns %			
1	Ngasein Super 5%	¼	80	15	5	0.65 & above	0.35 & above	-
2.	Emata Super 5%	1	80	15	5	0.65 & above	0.35 & above	6
3.	Ngasein Super 10%	¼	75	15	10	0.65 & above	0.35 & above	-
4.	Emata Super 10%	1	75	15	10	0.65 & above	0.35 & above	6
5.	Zeera	1	75	15	10	0.65 & above	0.35 & above	6
6.	Ngasein Burma 15%	½	70	15	15	0.625 & above	1 & 2	-
7.	Emata Burma 15%	2	65	15	15	0.625 & above	1 & 2	6
8.	Zeera Burma 15%	2	65	20	15	0.625 & above	1 & 2	6
9.	Ngasein Burma 25%	1	60	15	25	Above -0.5	1, 2 & 3	-
10.	Emata Burma 25%	2	60	15	25	0.625 & above	1 & 2	6
11.	Zeera Burma 25%	2	60	15	25	0.625 & above	1 & 2	6
12.	Ngasein S.M.S. 35%	2 to 3	50	15	35	Above 0.5	1, 2 & 3	-
13.	Emata S.M.S. 35%	2	50	15	35	0.625 & above	1, 2 & 3	6
14.	Zeera S.M.S. 35%	2	50	15	35	0.625 & above	1, 2 & 3	6
15.	Milchar No. 1 8%	1	80	12	8	Above 0.5	1 & 2	6
16.	Ngasein Full Boiled 12%	3 to 4	74	14	12	Above 0.5	1 & 2	6
17.	Long Boiled 10%	1	80	10	10	0.625 & above	1 & 2	6

Source: Tun U than, 1985.

IV. Appendix Table 2.4.1.2 — Specifications of Burmese (Myanmar) Loonzain Rice

Sl. No.	Quality	Milling	Head	Big Bkns (%)	Bkns (%)	Size big bkns	Or Bkns	Remarks
1.	Ngasein Loonzain 5%	Husked	+ 90	- 3	- 7	+0.70 0.80	+0.40 0.70	+ not less than - not more than
2.	Emata Loonzain 5%	Husked	+ 90	- 3	- 7	+0.70 -0.80	+0.35 -0.70	
3.	Zeera Loonzain 5%	Husked	+ 87	- 5	- 8	+0.70 -0.80	+0.40 -0.70	
4.	Ngasein Loonzain 12%	Husked	66	8	12	Above	1,2&3	Red 12

Source: Tun U than, 1985.

N.B. Maximum allowance of admixture for Ngasein Loonzain 5%, Emata Loonzain 5% and Zeers Loonzain 5% are as follows:

1. Paddy 1%
2. Foreign grain 2%
3. Red kernel 6%
4. Split and small brokens 1%
5. Damaged grain
  - a) 4% during 1<sup>st</sup> half of the year
  - b) 8% during 2<sup>nd</sup> half of the year
6. Moisture Not more than 14%

V. Appendix Table 2.4.1.3 — Specifications of Broken Rice

Sl. No.		Composition				Free tolerance		
		Extra	No. 1%	No. 2%	No. 3%	No. 4%	Lower grades (%)	Points and dusts (%)
1	A extra mixed	100					10	1
2	A2 & extra mixed	60	40				5	1
3	A1		100				10	1
4	A2		100				10	1
5	A1 & 2 mixed		50	50			5	1
6	A2, 3 & mixed			25	50	25	5	1
7	B extra	100					10	1
8	B1 & extra mixed	60	40				5	1
9	B1		100				10	1
10	B2			100			10	1
11	B1 & 2 mixed			50			5	1
12	B2, 3 & 4 mixed		50	25	50	25	5	2
13	Ordinary 2, 3 and 4 mixed			25	50	25	50	2
14	Boiled broken rice (2, 3 & 4 mixed)			25	50	25	5	2
15	Cargo broken rice						No splits	-

Source: Tun U Than, 1985.

**The explanation of the specifications:**

- i. Milling degree: The proportion of epidermis existing on the dorsal grooves and surface of the grain.
- ii. Imperfect grain:
  - a) Immature grain: The grain is not plump and the outside looks completely chalky and lustreless.
  - b) Infested grain: The grain is infested with insects and disease.
- iii. Impurity:
  - a) Bran: The throughs of 1 mm round-hole screen and the powdered matters stick on the screen.
  - b) Minerals: Sand, coal cinder, bricks etc.
  - c) Barnyard milled with husk and rice with husk.
  - d) Other impurities: Inedible rice, other grains etc.
- iv. Yellow rice: The colour of endosperm is yellow and quite different from that of normal rice.
- v. Broken rice:
  - a) Big broken: The over on 2 mm round-hole screen and smaller than  $\frac{2}{3}$  of head rice.
  - b) Small broken: The throughs of 2 mm round-hole screen and the over on 1 mm round-hole screen.
- vi. Colour, odour and taste: The overall colour, odour and taste of one batch of rice.

## Appendix 2.5 — Standard Specifications for Milled Rice of Pakistan

### Appendix Table 2.5.1 — Specifications of Basmati White and Parboiled (Pakistan)

Sl. No.	Item of refraction	Tolerance limit	Remarks
1.	<b>Full Healthy grains</b>	71%	If any refractions increases from tolerance limit it is accepted with a certain deduction in price.
	Admixture of other varieties	5%	
	a) Fine grain varieties	5%	
	b) Medium grain varieties		
2.	<b>Broken Grains</b>		If any refractions increases from tolerance limit it is accepted with a certain deduction in price
	a) Over $\frac{1}{4}$ to $\frac{3}{4}$ of Basmati	10% 1.5%	
	b) Of other varieties	1%	
	c) % and below		
3.	Red and undermilled grains	1%	
4.	Chalky grains	4%	
5.	Damaged, discoloured, shreivelled grains	1%	
6.	Foreign rather including Rice Jowaer (Nakko)	0.5%	
7.	Paddy (in 500 grains)	0.2%	

Notes: i) Broken grains above  $\frac{3}{4}$  are count as full grains.

ii) Moisture content does not exceed 14%.

Source: Malik M. A. 1985.

### Appendix Table 2.5.2 — Specifications of Special Quality Basmati

1.	<b>Admixture of other varieties</b>	
	i) Fine grain varieties	5.0%
	ii) Medium grain varieties	5.0%
2.	<b>Broken total (a and b)</b>	7.0%
	a) $\frac{1}{4}$ size to $\frac{1}{2}$	4.0%
	b) Below $\frac{1}{2}$ size to $\frac{1}{4}$	3.0%
3.	<b>Undermilled and red striped</b>	2.0%
4.	Chalky grains	4.0%
5.	Foreign matter	0.2%
6.	Paddy	0.2%
7.	Damaged shrivelled and yellow grains etc.	0.5%
8.	Moisture	14.0%

**Appendix Table 2.5.3 — Specifications of Irri-6 (a) and Irri-6 Arsceled (S.I.A.)**

Sl. No.	Items of refractions	Tolerance limit %	Remarks
1.	Broken grains	15%	
	a) Below 3/4 to 1/4	14%	If any refractions increases from tolerance limit is accepted with certain deduction in price.
	B) Below 1/4	1%	
2.	Red and underrilled grains	2%	
3.	Damaged, discoloured & shrievelled grains	1.5%	
4.	Chaiky grains	3%	
5.	Foreign matter & paddy	0.5%	
6.	Other varieties	3%	

Notes: 1. During analysis the brokens of red, undermilled, chalky, white sellied, damaged and discoloured and shrievelled grains are considered as broken grains.  
2. Moisture contents shall not exceed 14%.

Source: Malik M. A. 1985.

#### **Definition of quality factors**

1. Red and under-miller grains – kernels of rice having one fourth or more surface area covered with husk or bran and/or having one fourth or more surface area covered with red coating.
2. Damaged kernels shall include kernels of rice partially/wholly eaten/bored by insects and/or distinctly damaged by water, fungi, heat or other means.
3. Discoloured kernels – Kernels which due to any reason are not of the normal colour.
4. Immature and dead kernels – Kernels which are not fully developed and are greenish in colour.
5. Over-cooked kernels – It means grains that are damaged in cooking, but not grains that are lightly dark, but otherwise sound.
6. Chalky kernels – Kernels of rice of which half or more are chalky. Such grains have chalky white appearance and are opaque.
7. White bellied kernels – Kernels of parboiled rice of which half or more are opaque.
8. Paddy – Rice is husk after threshing.
9. Foreign matter – Shall include all matters other than rice kernels.

**Appendix 2.6 — Standard Specifications for Milled Rice of China.****Appendix 2.6.1 — Explanation of Chinese Milled Rice Specifications**

- i. Milling degree: The proportion of epidermis existing on the dorsal grooves and surface of grain.
- ii. Imperfect grain:
  - a) Immature grain: The grain is not plump and the outside looks completely chalky and lustreless.
  - b) Infested grain: The grain is infested by insects and disease.
- iii. Impurity:
  - a) Bran: The throughs of 1 mm round-hole screen and the powdered matters stucked on the screen.
  - b) Minerals: Sand, coal cinder, bricks etc.
  - c) Barnyard milled with husk and rice with husk.
  - d) Other impurities: Inedible rice, other grains etc.
- iv. Yellow rice: The colour of endosperm is yellow and quite different from that of normal rice.
- v. Broken rice:
  - a) Big brokens: The over on 2mm round-hole screen and smaller than 2/3 of head rice.
  - b) Small brokens: The throughs of 2mm round-hole screen and the over on 1 mm round-hole screen.
- vi. Colour, odour and taste: The overall colour, odour and taste of one batch of rice.

Appendix Table 2.6.2 — Early Xian Rice and Xian Glutinous Rice

Grade	Milling degree	Imperfect grain (%)	Max. tolerance for impurities			Paddy grain/kg	Brokens (%) Total	Moisture (%)	Colour odour taste
			Total (%)	Bran (%)	Minerals (%)				
Super grade	Epidermis existing on the dorsal grooves, over 85% of grains with epidermis cleaned off	3	0.25	0.15	0.02	8			
Grade 1	Epidermis existing on the dorsal grooves, over 80% of grains with epidermis not over 1/5	4	0.35	0.20	0.02	12	35	14.0	Normal
Grade 2	Epidermis existing on the dorsal grooves, over 75% of grains with epidermis not over 1/3	6	0.40	0.25	0.02	16	2.5		
Grade 3	Epidermis existing on the dorsal grooves, over 70% of grains with epidermis not over 1/2	8	0.45	0.25	0.02	20			



Appendix Table 2.6.3 — Late Xian Rice

Grade	Milling degree	Imperfect grain (%)	Max. tolerance for impurities				Paddy grain/kg	Brokens (%)		Moisture (%)	Colour odour taste
			Total (%)	Bran (%)	Minerals (%)	Millet with husk, grain/kg		Total	Small		
Super grade	Epidermis existing on the dorsal grooves, over 85% of grains with epidermis cleaned off	3	0.25	0.15	0.02	20	8				
Grade 1	Epidermis existing on the dorsal grooves, over 80% of grains with epidermis not over 1/5	4	0.30	0.20	0.02	12	6	30	2.0	14.5	Normal
Grade 2	Epidermis existing on the dorsal grooves, over 75% of grains with epidermis not over 1/3	6	0.40	0.20	0.02	70	16				
Grade 3	Epidermis existing on the dorsal grooves, over 70% of grains with epidermis not over 1/2	8	0.45	0.20	0.02	840	20				

Appendix Table 2.6.4 — Early Geng Rice

Grade	Milling degree	Imperfect grain (%)	Max. tolerance for impurities				Paddy grain/kg	Brokens (%)		Moisture (%)	Colour odour taste
			Total (%)	Bran (%)	Minerals (%)	Millet with husk, grain/kg		Total	Small		
Super grade	Epidermis existing on the dorsal grooves, over 85% of grains with epidermis cleaned off	3	0.25	0.15	0.02	20	4				
Grade 1	Epidermis existing on the dorsal grooves, over 80% of grains with epidermis not over 1/5	4	0.30	0.20	0.02	50	6	30	20	14.5	Normal
Grade 2	Epidermis existing on the dorsal grooves, over 75% of grains with epidermis not over 1/3	6	0.40	0.20	0.02	70	8				
Grade 3	Epidermis existing on the dorsal grooves, over 70% of grains with epidermis not over 1/2	8	0.45	0.20	0.02	80	10				

Appendix Table 2.6.5 — Late Geng Rice and Geng Glutinous Rice

Grade	Milling degree	Imperfect grain (%)	Max. tolerance for impurities				Paddy grain/kg	Brokens (%)		Moisture (%)	Colour odour taste
			Total (%)	Bran (%)	Minerals (%)	Millet with husk, grain/kg		Total	Small		
Super grade	Epidermis existing on the dorsal grooves, over 85% of grains with epidermis cleaned off	3	0.20	0.15	0.02	10	4				
Grade 1	Epidermis existing on the dorsal grooves, over 80% of grains with epidermis not over 1/5	4	0.25	0.20	0.02	20	6	15	1.5	15.5	Normal
Grade 2	Epidermis existing on the dorsal grooves, over 75% of grains with epidermis not over 1/3	6	0.30	0.20	0.02	40	8				
Grade 3	Epidermis existing on the dorsal grooves, over 70% of grains with epidermis not over 1/2	8	0.35	0.20	0.02	40	10				

Source: Zhiying Fong, 1985.

## Appendix 2.7 — Standard Specifications for Milled Rice of Japan

## Appendix Table 2.7.1 — Quality Standards for Fully Milled Rice

## a. Milled rice

Grade	Minimum		Maximum					
	Shape quality	Moisture content %	Chalky and damaged kernel			Broken kernel %	Foreign grains and foreign materials	
			Total %	Damaged kernel Total %	Coloured kernel %		Paddy %	Except paddy %
1st	1st grade standard sample	15.0	10	1	0.0	5	0.0	0.0
2nd	2nd gr.s	15.0	20	2	0.2	10	0.0	0.1
Sub-	Sub-gr.s	15.0	25	4	0.2	15	0.0	0.2

Off grade: Milled rice that does not fall into each of the above and does not contain more than 50% of foreign grains and foreign materials.

**Definitions**

- Percentage : All percentage shall be determined upon the basis of weight.
- Shape and quality : Shape and quality shall be the degree at which bran layers have been removed and the degree at which bran adhere to kernels of milled rice. Uniformity of grain size and condition of mature kernels.
- Moisture : Moisture shall be ascertained by the air-oven method (105<sup>0</sup>C) or ascertained by any method which gives equivalent results.
- Chalky kernels : Chalky kernels shall be the kernels of rice each of which is one half or more chalky.
- Damaged kernels : Damaged kernels shall be kernels of rice, except broken kernels, which are damaged by insects, water, heat, fungi, bacteria or any other causes.
- Coloured kernels : Coloured kernels shall be the damaged kernels of rice which have yellowish brown, brown or red surface.
- Broken kernels : Broken kernels shall be pieces of kernels of rice which are 2/3 to 1/4 (the size of pieces of kernels that will remain on the wire sieve 1.7mm in square) of the length of the whole kernels.

- Foreign grain : Foreign grain shall be kernels of any grain other than kernels of milled rice of this class.
- Foreign material : Foreign material shall be the pieces of kernels of rice which are less than 1/4 of the length of the whole kernel and all matter except for kernels of any grain.

### **Milled Rice Analysis Process**

#### 1. Shape and Quality

Whenever it is necessary to judge accurately the degree of bran removal (milling degree), NMG dyeing solution is used.

#### 2. Moisture Content

105°C air oven drying method or electric moisture meter.

Contract the 20g sample and separate the chalky grains, damaged grains and broken grains by hand and measure the weight of each down to 0.1g unit. Obtain the percentage of each.

3. Damaged grain
4. Broken grain
5. Chalky grain.

Figures in measurement and calculations.

- a. For values of chalky grains, damaged grains and broken grains, round off the fractions to one decimal place and make it an integer.
- b. For moisture content, coloured grain, foreign grains and foreign matter, round off the fractions to two decimal places.

Contract the sample to 100 g and separate coloured grain, foreign grain and foreign matters by hand. Measure the weight of each down to 0.1 g unit and work out percentages.

- a. Foreign grains are measured twice, the paddy and others.
- b. Foreign material is anything other than grain plus the particles dropped under the 1.7 mm officially designated sieve.

#### 6. Coloured grain

7. Foreign grain
8. Foreign material.

### **2.7.2 Inspection by agricultural produce inspection law**

Inspection of agricultural produce is roughly divided into two; the inspection on quality as the commodity such as kind, year of production, brand and grade, and the inspection on the quantity of commodity such as weight and packing mode.

#### **1. Inspection on Quantity and Packing**

##### **(i) Inspection of quantity**

Inspection of quantity and packing means judging whether the net weight and gross weight including packings are correct or not.

##### **(ii) Inspection of packing**

Kind, materials of packing, the method of rope tying and degree of tightness are inspected.

#### **2. Inspection of kind**

The type of rice is divided into lowland non-glutinous brown rice, lowland glutinous brown rice, upland non-glutinous brown rice, upland glutinous brown rice and brown rice for brewery. Inspection of kind is to judge what kind of rice it is.

#### **3. Inspection on Year of Production**

It is useful to clearly indicate the year of production and date of processing for the smooth trade and marketing because agricultural produce generally changes, decrease in quantity and quality as time goes by.

Inspection of production year is to judge the year in which the rice is produced.

The method of judgment is as follows:

- (1) It is very difficult to judge the year of production if the rice is produced before and including previous year.

Therefore, generally it is judged by confirming if the rice is production year described in the application form.

- (2) In the inspection of production year for the rice that is considered to be mixture of newly harvested rice and the rice harvested in previous year or before the previous year, the rice shall be considered to have been produced in the previous year and the inspection standard sample of previous year shall be applied.
- (3) Whenever there is doubt about the year of production, the rice is judged by the Standard Measuring Method, which includes judgment of new and old rice.

#### 4. **Inspection of Brand ("Meigara")**

If characteristics of a certain variety of rice show a remarkable difference from other varieties when grown in certain areas, it is handled as brand ("meigara"). Therefore, inspection of brand is done in the production area and on the variety of rice.

#### 5. **Inspection of Grade**

##### (i) **Standard Sample for Inspection**

a) The Inspection Standard Sample is an actual sample of rice that shows the shape and quality of the each item as the grades are described in the Agriculture Produce Standards.

##### b) **Basic Standard Sample**

In case of brown rice, degree of following items are generally shown by the standard sample; namely, thickness of bran layers, degree of maturity, hard or soft in texture, uniformity of grain size, shape, lustre and surface damage, chalky belly and chalky chore.

##### c) **Standard Sample for Actual Use**

This is made according to the basic standard sample taking into consideration the variety and maturing condition each year in each preference. It is carried by inspectors and used to determine the grades. Both samples require assessments by the organizations concerned in the field of production, distribution, consumption and others. The standard samples are to be prepared every year because they change in quality as time passes by.

##### (ii) **Inspection Method**

Grade inspection is to be made by checking the rice from each unit or extracted samples on each item of the grades enacted by the Minister of Agriculture Forestry & Fisheries according to the standards (standard figures and standard samples) visually and by Standard Testing Method using instruments, chemicals, etc. Physico-chemical determinations).

#### 6. **Method of Grade Inspection**

##### (1) **Method of Collecting Inspection Sample**

There are differences in quality depending on the position of the sample in the bag. In order to take representative samples rationally, following are necessary.

- a. Take out the sample by probe from both ends of Tawara (straw bag) or both upper and lower part in case of Kamasu (other kind of straw bag) and jute bag. If the representativity of the sample by this method is not considered enough, take out further sample from the centre of each container mentioned above.
- b. In case of paper bag, principally let the inspected open the bag and inspector should take out the sample by carton (sample pan). If the representativity is considered not sufficient, it is necessary to take out more sample from the bottom of paper bag by probe made for paper bag.

**(ii) Inspection of Milled Rice**

- a. Shape and quality  
The degree of bran removed and the degree of bran still attached to the surface of grain, uniformity of grain shape and size and degree of chalky belly and chalky core grain. Those items are generally judged after comparison with the standard sample. When there is a need to judge clearly the milling degree apply dyeing method (using NMG solution) according to the Standard Measuring Method, item title "Judgement of Milling Degree".
- b. Moisture Content  
105BC air oven drying method shall be applied. In actual practice however, electric moisture meters which are adjusted to give the same results as the 105BC drying method are used.
- c. Damaged Grain  
It means contaminated and damaged grain (except broken rice). In principle, judgement is made by visual inspection but whenever necessary analysis shall be conducted.
- d. Broken Grain  
It means the grains of  $2/3$ - $1/4$  size of the full grain. (those which stay on the sieve, made of #25 wire and 1.7 mm opening. In principle, judgement is made by visual inspection, but whenever necessary analysis shall be conducted.
- e. Chalky Grain



It means grain with powderly or semi-powderly condition. In principle, judgement is made by visual inspection but whenever necessary, analysis shall be conducted.

- f. Coloured Grain  
Partially or totally discoloured grain and red rice excepting the ones that will not affect the quality of the milled rice remarkably.
- g. Foreign Grain  
It is the grain other than the milled rice of that kind (milled rice in case of milled glutinous rice) to be inspected. In principle, judgement is to be made visually but whenever necessary, analysis shall be conducted.
- h. Foreign Material  
Milled rice of less than  $\frac{1}{4}$  size and anything other than grain. In principle, judgement is made by visual inspection but whenever necessary analysis is made by using an official sieve of 1.7 mm.

#### Appendix 2.8.1 — Standard Specifications for Milled Rice of Thailand (BE 2541, AD 1998)

##### Section 1: Definitions

The meaning of the terminology in this Rice Standards is as follows:

1. **Rice Standards** means the minimum specifications for rice of each type and grade for domestic trade and international trade.
2. **Rice** means non-glutinous and glutinous rice (*Oryza sativa* L.) in whatever form.
3. **Paddy** means rice that is not yet dehusked.
4. **Cargo rice** (Loonzain rice, Brown rice, Husked rice) means rice that is dehusked only.
5. **White rice** means rice that is obtained by removing bran from Cargo non-glutinous rice.
6. **White glutinous rice** means rice that is obtained by removing bran from Cargo glutinous rice.
7. **Parboiled rice** means non-glutinous rice that has passed through the parboiling process and has its bran removed.

8. **Rice classification** means rice kernels of various lengths as specified which are the *mixture of rice kernels of each class in accordance with the specified proportion.*
9. **Classes of rice kernels** mean classes of rice kernels which are classified in accordance with the length of the whole kernel.
10. **Parts of rice kernels** mean each part of the whole kernel that is divided lengthwise into 10 equal parts.
11. **Whole kernels** mean rice kernels that are in whole condition without any broken part, including the kernels that have the length as from 9 parts onward.
12. **Head rice** means broken kernels whose lengths are more than those of Broken but have not reached the length of the whole kernel. This includes split kernels that retain the area as from 80% of the whole kernel.
13. **Broken** mean broken kernels that have the length as from 2.5 parts but have not reached the length of Head rice. This includes split kernels that retain the area less than 80% of the whole kernel.
14. **Small broken C1** mean small broken kernels that pass through round hole metal sieve No.7.
15. **Undermilled kernels** mean milled rice kernels that have the milling degree below that specified for each grade of rice.
16. **Red kernels** mean rice kernels that have red bran covering the kernels wholly or partly.
17. **Yellow kernels** mean rice kernels that have some parts of the kernels turn yellow obviously. This includes parboiled rice kernels that are light brown partly or wholly.
18. **Black kernels** means parboiled rice kernels that are black for the whole kernels, including kernels that are dark brown for the whole kernels.
19. **Partly black kernels** mean parboiled rice kernels that have black or dark brown area on the kernels as from 2.5 parts onward but not reaching the whole kernels.
20. **Peck kernels** mean parboiled rice kernels that have obviously black or dark brown area on the kernels not reaching 2.5 parts.
21. **Chalky kernels** mean non-glutinous rice kernels that have an opaque area like chalk covering the kernels as from 50% onward.
22. **Damaged kernels** mean kernels that are obviously damaged as can be seen by the naked eyes due to moisture, heat, fungi, insects or other.
23. **Undeveloped kernels** mean kernels that do not develop normally as should be, and are flat without starch.
24. **Immature kernels** mean rice kernels that are light green, obtained from immature paddy.

25. **Other seeds** mean seeds of other plants than rice kernels.
26. **Foreign matter** means other matter than rice. This includes rice husk and bran detached from rice kernels.
27. **Milling degree** means the degree to which the rice is milled.
28. **Sieve** means round hole metal sieve No. 7, that is 0.79 mm. (0.031 inch) thick and with hole diameter of 1.75 mm. (0.069 inch).
29. The unit "**per cent**" means percentage by weight except for per cent of grain classification which is percentage by quantity.

### **Section 2: Classes of Rice Kernels and Milling degree**

30. Classes of rice kernels are divided into 4 classes as follows:
  - 30.1 **Long grain Class 1** is whole kernel having the length exceeding 7.0 mm.
  - 30.2 **Long grain Class 2** is whole kernel having the length exceeding 6.6 mm. upto 7.0 mm.
  - 30.3 **Long grain Class 3** is whole kernel having the length exceeding 6.2 mm. upto 6.6 mm.
  - 30.4 **Short grain** is whole kernel having the length not exceeding 6.2 mm.
31. **Milling degree** is divided into 4 degrees as follows:
  - 31.1 **Extra well milled** is the removal of bran entirely to the extent that the rice kernel has a specially beautiful appearance.
  - 31.2 **Well milled** is the removal of bran entirely to the extent that the rice kernel has a beautiful appearance.
  - 31.3 **Reasonably well milled** is the removal of a large amount of bran to the extent that the rice kernel has a reasonably beautiful appearance.
  - 31.4 **Ordinarily milled** is the removal of some portions of bran only.

### **Section 3: Types and Grades of rice**

32. **Types of rice** are divided into 4 types as follows:
  - 32.1 White rice
  - 32.2 Cargo rice (Loonzain rice, Brown rice, Husked rice)
  - 32.3 White glutinous rice
  - 32.4 Parboiled rice
  
36. **Grades of Parboiled rice** are divided into 9 grades as follows:

- 36.1 Parboiled rice 100% Sorted
- 36.2 Parboiled rice 100%
- 36.3 Parboiled rice 5% Sorted
- 36.4 Parboiled rice 5%
- 36.5 Parboiled rice 10% Sorted
- 36.6 Parboiled rice 10%
- 36.7 Parboiled rice 15%
- 36.8 Parboiled rice 25%
- 36.9 Parboiled broken rice A1

#### **Section 4: Standards for Parboiled Rice**

The standards for Parboiled rice are specified as follows:

##### **Parboiled rice 100% Sorted**

shall have grain classification, grain composition and milling degree as follows:

##### **Grain classification**, comprising of:

- Long grain Class 1 and Class 2 combined not less than 60.0%; the rest shall be Long grain Class 3.
- Of all these there may be Short grain not exceeding 10.0%

##### **Grain composition**, comprising of:

- Whole kernels not less than 80.0%
- Broken having the length as from 5.0 parts onward, but not reaching 8.0 parts, are not to exceed 4.0%. Of these there may be broken having a length not reaching 5.0 parts, not passing through sieve No. 7, not exceeding 0.5%, and Small parboiled broken C1 not exceeding 0.1%
- The rest shall be Head rice having the length as from 8.0 parts onward.

##### **Rice and matter that may be present:**

- Red kernels and/or Undermilled kernels not exceeding 0.5%
- Yellow kernels not exceeding 0.25%
- Black kernels not exceeding 0.1%
- Partly black kernels and Peck kernels combined not exceeding 1.5%, of which Partly black kernels shall not exceed 0.5%
- Damaged kernels not exceeding 1.0%
- Glutinous rice not exceeding 1.5%
- Paddy not exceeding 3 grains per 1 kg. of rice
- Undeveloped kernels, immature kernels, other seeds and foreign matter, either singly or combined, shall not exceed 0.2%.

**Milling degree:** Extra well milled

##### **Parboiled rice 100%**

shall have grain classification, grain composition and milling degree as follows:

##### **Grain classification**, comprising of:

- Long grain Class 1 and Class 2 combined not less than 60.0%; the rest shall be Long grain Class 3.
- Of all these there may be Short grain not exceeding 10.0%

**Grain composition, comprising of:**

- Whole kernels not less than 80.0%
- Broken having the length as from 5.0 parts onward, but not reaching 8.0 parts, are not to exceed 4.0%. Of these, there may be broken having the length not reaching 5.0 parts, not passing through sieve No. 7, not exceeding 0.5%, and Small parboiled broken C1 not exceeding 0.1%
- The rest shall be Head rice having the length as from 8.0 parts onwards.

**Rice and matter that may be present:**

- Red kernels and or Undermilled kernels not exceeding 0.5%
- Yellow kernels not exceeding 0.5%
- Black kernels not exceeding 0.25%
- Partly black kernels and Peck kernels combined not exceeding 2.5%, of which Partly black kernels shall not exceed 1.0%
- Damaged kernels not exceeding 1.0%
- Glutinous rice not exceeding 1.5%
- Paddy not exceeding 5 grains per 1 kg. of rice
- Undeveloped kernels, immature kernels, other seeds and foreign matter, either singly or combined, shall not exceed 0.2%.

**Milling degree: Extra well milled****Parboiled rice 5% Sorted**

shall have grain classification, grain composition and milling degree as follows:

**Grain classification, comprising of:**

- Long grain Class 1 and Class 2 combined not less than 45.0%; the rest shall be Long grain Class 3.
- Of all these there may be Short grain not exceeding 20.0%

**Grain composition, comprising of:**

- Whole kernels not less than 80.0%
- Broken having the length as from 3.5 parts onward, but not reaching 7.5 parts, are not to exceed 7.0%. Of this there may be broken having the length not reaching 3.5 parts, not passing through sieve No. 7, not exceeding 0.5%, and Small parboiled broken C1 not exceeding 0.1%
- The rest shall be Head rice having the length as from 7.5 parts onward.

**Rice and matter that may be present:**

- Red kernels and or Undermilled kernels not exceeding 1.0%
- Yellow kernels not exceeding 0.5%

- Black kernels not exceeding 0.15%
- Partly black kernels and Peck kernels combined not exceeding 2.0%, of which Partly black kernels shall not exceed 0.75%
- Damaged kernels not exceeding 1.0%
- Glutinous rice not exceeding 1.5%
- Paddy not exceeding 5 grains per 1 kg. of rice
- Undeveloped kernels, immature kernels, other seeds and foreign matter, either singly or combined, shall not exceed 0.2%.

**Milling degree:** Well milled

**Parboiled rice 5%**

shall have grain classification, grain composition and milling degree as follows:

**Grain classification**, comprising of:

- Long grain Class 1 and Class 2 combined not less than 45.0%; the rest shall be Long grain Class 3.
- Of all these there may be Short grain not exceeding 20.0%

**Grain composition**, comprising of:

- Whole kernels not less than 80.0%
- Broken having the length as from 3.5 parts onward, but not reaching 7.5 parts, shall not exceed 7.0%. Of this there may be broken having a length not reaching 3.5 parts, not passing through sieve No. 7, not exceeding 0.5%, and Small parboiled broken C1 not exceeding 0.1%
- The rest shall be Head rice having the length as from 7.5 parts onward.

**Rice and matter that may be present:**

- Red kernels and or Undermilled kernels not exceeding 1.0%
- Yellow kernels not exceeding 1.0%
- Black kernels not exceeding 0.25%
- Partly black kernels and Peck kernels combined not exceeding 3.0%, of which Partly black kernels shall not exceed 1.5%
- Damaged kernels not exceeding 1.0%
- Glutinous rice not exceeding 1.5%
- Paddy not exceeding 10 grains per 1 kg. of rice
- Undeveloped kernels, immature kernels, other seeds and foreign matter, either singly or combined, shall not exceed 0.2%.

**Milling degree:** Well milled

**Parboiled rice 10% Sorted**

shall have grain classification, grain composition and milling degree as follows:

**Grain classification, comprising of:**

- Long grain Class 1 and Class 2 combined not less than 30.0%; the rest shall be Long grain Class 3.
- Of all these there may be Short grain not exceeding 20.0%

**Grain composition, comprising of:**

- Whole kernels not less than 75.0%
- Broken having the length as from 3.5 parts onward, but not reaching 7.0 parts, shall not exceed 12.0%. Of these there may be broken having the length not reaching 3.5 parts, not passing through sieve No. 7, not exceeding 0.7%, and Small parboiled broken C1 not exceeding 0.3%
- The rest shall be Head rice having the length as from 7.0 parts onward.

**Rice and matter that may be present:**

- Red kernels and or Undermilled kernels not exceeding 2.0%
- Yellow kernels not exceeding 0.75%
- Black kernels not exceeding 0.2%
- Partly black kernels and Peck kernels combined not exceeding 2.5%, of which Partly black kernels shall not exceed 1.0%
- Damaged kernels not exceeding 1.5%
- Glutinous rice not exceeding 1.5%
- Paddy not exceeding 5 grains per 1 kg. of rice
- Undeveloped kernels, immature kernels, other seeds and foreign matter, either singly or combined, shall not exceed 0.4%.

**Milling degree:** Well milled

**Parboiled rice 10%**

shall have grain classification, grain composition and milling degree as follows:

**Grain classification, comprising of:**

- Long grain Class 1 and Class 2 combined not less than 30.0%; the rest shall be Long grain Class 3.
- Of all these there may be Short grain not exceeding 20.0%

**Grain composition, comprising of:**

- Whole kernels not less than 75.0%
- Broken having the length as from 3.5 parts onward, but not reaching 7.0 parts, shall not exceed 12.0%. Of this there may be broken having a length not reaching 3.5



parts, not passing through sieve No. 7, not exceeding 0.7%, and Small parboiled brokens C1 not exceeding 0.3%

- The rest shall be Head rice having the length as from 7.0 parts onward.

**Rice and matter that may be present:**

- Red kernels and or Undermilled kernels not exceeding 2.0%
- Yellow kernels not exceeding 1.5%
- Black kernels not exceeding 0.25%
- Partly black kernels and Peck kernels combined not exceeding 3.5%, of which Partly black kernels shall not exceed 2.0%
- Damaged kernels not exceeding 1.5%
- Glutinous rice not exceeding 1.5%
- Paddy not exceeding 10 grains per 1 kg. of rice
- Undeveloped kernels, immature kernels, other seeds and foreign matter, either singly or combined, shall not exceed 0.4%.

**Milling degree:** Well milled

**Parboiled rice 15%**

shall have grain classification, grain composition and milling degree as follows:

**Grain classification, comprising of:**

- Long grain Class 1 and Class 2 combined not exceeding 25.0%, the rest shall be Long grain Class 3.
- Of all these there may be Short grain not exceeding 30.0%

**Grain composition, comprising of:**

- Whole kernels not less than 70.0%
- Brokens having the length as from 3.0 parts onward, but not reaching 6.5 parts, are not to exceed 18.0%. Of this there may be brokens having the length not reaching 3.0 parts, not passing through sieve No. 7, not exceeding 1.0%, and Small parboiled brokens C1 not exceeding 1.0%
- The rest shall be Head rice having the length as from 6.5 parts onward.

**Rice and matter that may be present:**

- Red kernels and or Undermilled kernels not exceeding 5.0%
- Yellow kernels not exceeding 2.0%
- Black kernels not exceeding 0.5%
- Partly black kernels and Peck kernels combined not exceeding 4.0%, of which Partly black kernels shall not exceed 2.5%
- Damaged kernels not exceeding 1.5%

- Glutinous rice not exceeding 2.5%
- Paddy not exceeding 10 grains per 1 kg. of rice
- Undeveloped kernels, immature kernels, other seeds and foreign matter, either singly or combined, shall not exceed 0.7%.

**Milling degree:** Reasonably well milled

**Parboiled rice 25%**

shall have grain classification, grain composition and milling degree as follows:

**Grain classification,** comprising of:

- Long grain Class 1 and Class 2 combined not less than 20.0%, the rest shall be Long grain Class 3.
- Of all these there may be Short grain not exceeding 30.0%

**Grain composition,** comprising of:

- Whole kernels not less than 60.0%
- Broken having the length not reaching 5.0 parts and not passing through sieve No. 7 not exceeding 28.0%. Of this there may be Small parboiled broken C1 not exceeding 2.0%
- The rest shall be Head rice having the length as from 5.0 parts onward.

**Rice and matter that may be present:**

- Red kernels and or Undermilled kernels not exceeding 7.0%
- Yellow kernels not exceeding 3.0%
- Black kernels not exceeding 0.75%
- Partly black kernels and Peck kernels combined not exceeding 4.5%, of which Partly black kernels shall not exceed 3.0%
- Damaged kernels not exceeding 1.5%
- Glutinous rice not exceeding 2.5%
- Paddy not exceeding 10 grains per 1 kg. of rice
- Undeveloped kernels, immature kernels, other seeds and foreign matter, either singly or combined, shall not exceed 0.1%.

**Milling degree:** Ordinarily milled

**Parboiled broken rice A1**

is obtained from the milling of Parboiled rice of various grades and shall have Grain composition as follows:

**Grain composition,** comprising of:

- Brokens having the length not reaching 6.0 parts and not passing through sieve No. 7 for the entire quantity. Of this there may be brokens having the length as from 6.0 parts onward and Whole kernels combined not exceeding 10.0%, and Small parboiled brokens C1 not exceeding 6.0%

**Matter that may be present:**

- Other seeds and Foreign matter not exceeding 1.0%

**Section 5: General Provisions**

**Moisture Content of Rice**

The moisture content of rice of all types and grades is specified not exceeding 14.0%

**Type of rice sample**

In case the purchase and sale of rice is made on basis of the type sample that does not come within the specifications of this standards, the standards of such rice shall be in accordance with the sample and the specifications agreed upon by the buyer and the seller, and shall be approved by Department of Foreign Trade.

**Dispute**

In case of a dispute or different understanding on the features of the rice kernels in accordance with Section 1 and 2 the latest samples established by Department of Foreign Trade shall be used as standard basis. The decision of Department of Foreign Trade is final.

---

Notes: The rice standards in Thai version is authentic and valid in case of dispute.

Appendix Table 2.8.2 — Section 7 Standards for Parboiled Rice (Thailand)

Grades	Grain Classification (%)			Size of Head rice (Parts)	Size of Broken (Parts)	Grain composition (%)					Rice and Matter that may be present, not exceeding (%)								Milling degree	
	Long Grain		Short grain ≤6.2 mm.			Whole kernels	Head rice	Broken and Small broken C1			Red and or Under milled kernels	Yellow kernels	Black kernels	Partly black and Pack kernels		Damaged kernels	Glutinous rice	Undeveloped Immature kernels, other seeds and foreign matter, singly or combined		Paddy (Grains per 1 kg)
	Class 1+2 >6.6mm	Class 3 >6.2-6.6 mm.						Total (including broken not passing through sieve No. (7 & C1)	Broken not reaching the minimum specified parts and not passing through sieve No.7	Small broken C1				Total	Partly black kernels					
100% Sorted	≥60	-	≤10	≥8.0	≥5.0- <8.0	≥80	-	≤4	≤0.5	≤0.1	0.5	0.25	0.1	1.5	0.5	1	1.5	0.2	3	Extra well milled
100%	≥60	-	≤10	≥8.0	≥5.0- >8.0	≥80	-	≤4	≤0.5	≤0.1	0.5	0.5	0.25	2.5	1	1	1.5	0.2	5	Extra well milled
5% Sorted	≥45	-	≤20	≥7.5	≥3.5- <7.5	≥80	-	≤7	≤0.5	≤0.1	1	0.5	0.15	2	0.75	1	1.5	0.2	5	Well milled
5%	≥45	-	≤20	≥7.5	≥3.5- <7.5	≥80	-	≤7	≤0.5	≤0.1	1	1	0.25	3	1.5	1	1.5	0.2	10	Well milled
10% Sorted	≥30	-	≤20	≥7.0	≥3.5- <7.0	≥75	-	≤12	≤0.7	≤0.3	2	0.75	0.2	2.5	1	1.5	1.5	0.4	5	Well milled
10%	≥30	-	≤20	≥7.0	≥3.5- <7.0	≥75	-	≤12	≤0.7	≤0.3	2	1.5	0.25	3.5	2	1.5	1.5	0.4	10	Well milled
15%	≥25	-	≤30	≥6.5	≥3.0- <6.5	≥70	-	≤18	≤1.0	≤1.0	5	2	0.5	4	2.5	1.5	2.5	0.7	10	Reasonably well milled
25%	≥20	-	≤30	≥5.0	≥5.0	≥60	-	≤28	-	≤2.0	7	3	0.75	4.5	3	1.5	2.5	1	10	Ordinarily milled

< less than	≤ equal or less than
> more than	≥ equal or more than
- not specified	

**Appendix 2.9 — Standard Specifications for Milled Rice of Malaysia**

**Appendix Table 2.9.1 — Grade of Rice (Malaysia)**

Grade of rice	Symbol to denote Grade of rice
1. Malaysian Long Super	A <sub>1</sub>
2. Malaysian Long 10%	A <sub>2</sub>
3. Malaysian Long 25%	A <sub>3</sub>
4. Malaysian Long 45%	A <sub>4</sub>
5. Malaysian Medium Premium	B <sup>1</sup>
6. Malaysian Medium 10%	B <sub>2</sub>
7. Malaysian Medium 25%	B <sub>3</sub>
8. Malaysian Medium 45%	B <sub>4</sub>
9. Malaysian Short 10%	C <sub>1</sub>
10. Malaysian Short 25%	C <sub>2</sub>
11. Malaysian Short 45%	C <sub>3</sub>
12. Sample grade	S
13. Malaysian 100% brokens special	D <sub>1</sub>
14. Malaysian 100% brokens ordinary	D <sub>2</sub>
15. Malaysian pulut	E
16. Malaysian parboiled	F

**Appendix Table 2.9.2 — Specifications and Grading Requirements of the Grades of Rice**

Item No.	Grading factors	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3
1.	Length of grains (whole milled kernels)	6.2 mm or more	Same as in respect of A1	Same as in respect of A1	Same as in respect of A1	More than 5.2 mm but less than 6.2 mm	Same as in respect of B1	Same as in respect of B2	Same as in respect of B3	Less than 5.2 mm of C1	Same as in respect of C2	Same as in respect of C3
2.	Head rice (minimum % requirement)	95	80	65	45	95	80	65	45	80	65	45
3.	Big brokens (maximum % permissible, subject to paragraph 1(2) below)	3	10	10	10	3	10	10	10	10	10	10
4.	Brokens (other than big brokens) (maximum % permissible)	2	10	25	45	2	10	25	45	10	25	45

Item No.	Grading factors	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3
5.	Chalky and immature grains (Maximum % permissible)	2	7	10	10	2	10	15	15	10	15	15
6.	Damaged grains (Maximum % permissible)	0.5	2	4	4	0.5	4	6	6	4	6	6
7.	Contrasting lengths (Maximum % permissible)	2	6	10	10	2	10	15	15	10	15	15
8.	Red grains or thick red streaks (Maximum % permissible)	-	0.20	0.30	0.30	-	0.50	1.0	1.0	0.50	1.0	1.0
9.	Paddy seeds (maximum no. of grains permissible per 1,000 gms)	-	8	10	10	-	10	15	15	10	15	15

Item No.	Grading factors	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3
10.	Other seeds and foreign matter (maximum % permissible)	-	0.15	0.20	0.20	-	0.15	0.20	0.20	0.15	0.20	0.20
11.	Moisture content (maximum % permissible)	14	14	14	14	14	14	14	14	14	14	14
12.	Appearance (Vitreous) (maximum % requirement)	98	93	-	-	98	93	-	-	93	-	-
13.	Milling degree	Extra well milled	Reasonably well milled	Slightly under milled	Slightly under milled	Extra well milled	Reasonably well milled	Slightly under milled	Slightly under r milled	Reasonably well milled	Slightly under r milled	Slightly under milled

S	D1	D2	E	F
Rice which does not meet with the requirements of the grades set out in the columns preceding this column	Rice which consists of not less than 80% big brokens and not more than 20% brokens (Other than big brokens)	Broken rice which does not meet with the requirements of D1	Shall consist of 100% pulut grains and shall contain not less than 70% pulut head rice	Rice in which the starch in the kernel has been gelatinized by soaking, streaming and drying the rice and which consists of 100% parboiled grains and contains not less than 80% parboiled head rice



## Appendix 2.10 — Standard Specifications for Milled Rice of Indonesia

### Appendix Table 2.10.1 — Quantitative Specifications (Indonesia)

Physical aspects	Chemical aspects	Chalky grain	Yellow grain	Damaged grain	Red grain	Total
Head rice (2/3)		..	..	..	..	63% (approx.)
Broken rice (1/5 2/3)		..	..	..	..	35% max.
Brewer rice (1/5)		..	..	..	..	2% max.
		<b>3% max.</b>	<b>2% max.</b>	<b>1% max.</b>	<b>3% max.</b>	
Milling degree						95% (min.)
Moisture content						14% (max.)
Paddy grain						20 grain/kg
Foreign matter						0.05% max.
Bran						Free

## Appendix 2.11 — Standard Specifications for Milled Rice of Vietnam

### Vietnam Standards TCVN 5643: 1999 First revision

#### Rice - Terms and Definitions

##### 1. Scope of applications

This standard lays down general terms and definitions in relation to rice.

It includes the following parts: general conception, size, milling degree, and quality factors of rice.

##### 2. General Conception

2.1 Paddy: rough rice has retained its husk after threshing.

2.2 Rice: paddy from which the husk, all or a part of bran, and the embryo, has been removed.

2.3 Husked rice: paddy from which only the husk has been removed.

2.3 White rice: Husked rice, from which all or part of the bran, and the embryo, has been removed.

2.5 Glutinous rice, waxy rice, (*Oryza sativa* L glutinosa): rice, the kernels of which have a white and opaque appearance.

The colour and aroma of it are special. The starch of waxy rice consists mainly of amylopectin; after cooking, the kernel shaves have a tendency to stick together.

2.6 Aromatic rice: Rice has an aromatic fragrance.

2.7 Parboiled rice: Rice obtained from paddy or husked rice that has been soaked in water and subjected to a heat treatment so that the starch is fully gelatinized and followed by a drying process.

2.8 Muddy rice; Rice contaminated by mould that can be seen with the naked eye.

2.9 Dirty apparent rice: Rice which has had its natural colour changed by attached foreign matter on the surface of the kernels.

2.10 Consignment: Certain amounts of rice received or dispatched at one time covered by a particular contract or shipping documents. Consignments may consist of one or more lots.

2.11 Lot: Certain amounts of rice of the same quality, the same name or same code, packed in the same kind of packages and delivered at the same time.

2.12 Sample: An amount of rice drawn by a specified rule.

2.13 Increment (primary sample): The amount of rice drawn from one point of a single container in the lot.

2.14 Separate sample: Mixing all primary samples drawn from different positions of one package.

2.15 Bulk samples: The sample obtained by bringing together and mixing the primary sample or separate sample.

2.16 Laboratory sample: Prescribed quantity drawn from the bulk sample, representative of the lot, and intended for analysis or other examinations.

2.17 Analytical sample: The sample drawn from a laboratory sample and intended for examination.

### **3. Size of rice kernel**

3.1 Size of rice kernel: The length and the width of the unbroken rice kernel in mm.

3.2 Average length of rice kernel: Value obtained by calculating the arithmetic mean length of 100 unbroken kernels from a laboratory sample.

3.3 Classification of kernels: Classes of rice based on the length of rice kernels.

3.3.1 Very long kernel: Whole kernel that has a length exceeding 7.0 mm.

3.3.2 Long kernel: Whole kernel that has a length more than, or equal to 6.0 mm, but less than or equal to 7.0 mm.

3.3.3 Short kernel: Whole kernel that has a length of less than 6.0 mm.

#### 4. Milling degree of rice

Removal degree of bran and embryo of rice.

4.1 Extra - well milled: Rice obtained by milling husked rice in such a way that all layers of the bran, embryo and part of the germ have been removed.

4.2 Well - milled: Rice obtained by milling husked rice in such a way that all external bran, germ and most of the internal bran has been removed.

4.3 Reasonably milled: Rice obtained by milling husked rice in such a way that most of the germ and the bran have been removed.

4.4 Ordinary - milled: Rice obtained by milling husked rice in such a way that a part of the bran and the embryo have been removed.

#### 5. Quality factors of rice

5.1 Moisture: The loss of mass by heating rice at 105 °C until the mass of sample reaches constancy.

5.2 Impurities: (foreign matter) All the substances other than kernels of rice.

5.2.1 Inorganic impurities: Fragments of stone, sand, bran, and insects, etc.

5.2.2 Organic impurities: Foreign seed, husk, bran, and insects, etc.

5.3 Whole kernel: An unbroken kernel and broken kernel, the length of which is greater than, or equal to, 9/10 of the average length of a kernel (2.2)

5.4 Head rice: The whole kernel or part of kernel, the length of which is greater than 8/10 of the average length of a kernel.

5.5 Broken kernel: The part of the kernel the length of which is equal to, or greater than 2.5/10 but less than, or equal to, 8/10 of the average length of a kernel and does not pass through a metal sieve with a perforation outside diameter of 1.4 mm, and the size of a broken kernel to be determined by each grade of rice.

5.5.1 Large broken kernel: The part of a kernel the length of which is equal to or greater than 5/10 but less than or equal to, 8/10 of the average length of a kernel.

5.5.2 Medium broken kernel: The part of a kernel the length of which is equal to, or greater than 2.4/10 but less than or equal to 5/10 of the average length of a kernel.

5.6 Small broken kernel: The part of a kernel the length of which is less than 2.5/10 of the average length of a kernel that can pass through a metal sieve with a perforation outside diameter of 2.0 mm but does not pass through a metal sieve with a perforation outside diameter of 1.4 mm.

5.7 Chip: Fragments of a kernel, which pass through a metal sieve with a perforation outside diameter of 1.4 mm but do not pass through a metal sieve with a perforation outside diameter of 1.0 mm.

5.8 Other types of rice: (admixture) Rice kernels the size and shape of which are different from destination rice kernel.

5.9 Yellow kernel: Rice kernels that have a part, or all part, that turn to a visible yellow colour.

5.10 Chalky kernel: Rice kernels (except for waxy rice) whole or 3/4 surface of which has an opaque and floury appearance.

5.11 Damaged kernel: Rice kernels the quality of which were reduced obviously due to moisture, fungi, insect and other causes.

5.12 Heat damaged kernel (Using for parboiled rice): Rice kernels the natural colour of which have changed as a result of a microbiological activity, biochemical reaction, and / or due to overheating.

5.13 Immature and malformed kernel: Rice kernels are unripe and/or badly developed.

5.14 Red kernel: Rice kernel having a red colour covering more than one-quarter of its surface.

5.15 Red streaked kernel: Rice kernel with red streaks, the length of which is greater than, or equal to, one-half of the length of kernel, but the surface covered by these red streaks is less than one - quarter of the whole surface of kernel.

5.16 Under-milled rice kernel: Rice kernels covered by bran streaks, the length of which is greater than or equal to the length of the kernel or the surface of bran streaks is greater than one-quarter of the surface of the kernel.

5.17 Foreign odour: Not the natural aroma of rice.

5.18 Insect free - rice: Rice free from living insects, and less than five dead insects per kg.

5.19 Insected rice: Rice in which there are less than, or equal to, five living insects per kg but which should be free of *sitophilus granarius*.

5.20 Chemical residue: Residues of chemicals in rice.

**Appendix 2.12 — Standard Specifications for Milled Rice of Philippines**

**Appendix Table 2.12.1 — Quality Standards for Milled Rice Philippines**

PARAMETER	GRADE <sup>1</sup>			
	PREMIUM GRADE	GRADE NO. 1	GRADE NO. 2	GRADE NO. 3
* CLASSIFICATION				
Grain Size	Long/Medium/Short	Long /Medium/Short	Long/Medium/Short	Long/Medium/Short
Degree of Milling	Overmilled Rice (OVR) Well Milled Rice (WMR)	Well Milled Rice (WMR) Regular Milled Rice (RMR)	Well Milled Rice (WMR) Regular Milled Rice (RMR)	Well Milled Rice (WMR) Regular Milled Rice (RMR)
* VARIETY	Traditional/Modern	Traditional/Modern	Traditional/Modern	Traditional/Modern
* GRADE SPECIFICATIONS				
Headrice (min %)	95.00	80.00	65.00	50.00
Brokens (max %)	4.90	19.75	34.50	49.00
Brewers (max %)	0.10	0.25	0.50	1.00
Defectives:				
Damaged Grains (max %)	0	0.25	0.50	2.00
Discolored Grains (max %)	0.50	2.00	4.00	8.00
Chalky and Immature (max %)	2.00	5.00	10.00	15.00
Red Grains (max %)	0	0.25	0.50	2.00
Red Streaked Grains (max %)	1.00	3.00	5.00	10.00
Foreign Matter (max %)	0	0.10	0.20	0.50
Paddy (max no/Kg)	1.00	8.00	10.00	15.00
Moisture Content (max %)	14.00	14.00	14.00	14.00

Note: <sup>1</sup> Fancy Rice is not subject to standard grade specifications but must satisfy the general requirements and be identified under a specific variety such as Dinorado Sigadis, Milagrosa, Sampaguita, Sinandomeng, Kalinayan, Baysilanon, and other varieties certified by the National Seed Industry Council (NSIC)

Source: R R Gervacio, Jr. 1985

### Appendix 2.12.2 — Some Useful Definitions

- Brewers** - Small pieces or particles of grains that pass through a sieve having round perforations 1.4 millimeters in diameter. This is also known as "binlid" or "chips".
- Brokens** - Pieces of grains smaller than 8/10th of the average length of the unbroken grain.
- Brown Rice** - Palay from which the hull have been removed. This is also known as "dehulled rice" or husked rice".
- Chalky Grains** - Grains, whole or broken, one-half or more of which is white like the color of chalk and brittle.
- Damaged Grains (Milled Rice)** - Grains, whole or broken, which are distinctly damaged by insects, water, fungi and/or any other means.
- Damaged Grains (Palay)** - Grains which are sprouted or distinctly damaged by insects, water, fungi and/or any other means.
- Degree of Milling** - The extent in which the bran layers and germ have been removed in milled rice.
- Discolored Grains** - Grains that have changed their original color as a result of heating and other means. This is also known as "yellow grains" or "fermented grains".
- Fancy Variety Rice** - This refers to the milled rice of fancy palay varieties possessing special genetic characteristics in terms of color, aroma, flavor and other cooking and eating qualities that make them distinct from other rice varieties.
- Foreign Matter (Milled Rice)** - All matters other than rice grains, rice polishing and paddy such as weed seeds and other crop seeds.
- Grade No.** - A designation indicating the quality of rice and corn commodity determined with reference to its acquired characteristics (i.e. Premium, Grade No. 1, 2 and 3).
- Grade No. 1** - Any rice and corn variety which meet the second highest grade requirements for rice and corn as set forth in the herein prescribed national standards.

- Grade-2** - Any rice and corn variety which is lower in quality than Grade No. 1 but higher in quality than Grade No. 3 based on the grade requirements set forth in the herein prescribed national standards.
- Grade-3** - Any rice and corn variety which meet the lowest grade requirements for rice and corn as set forth in the herein prescribed national standards.
- Headrice** - A grain or a piece of grain with its length equal to or greater than 8/10th of the average length of the unbroken grain.
- Immature Grains** - Grains which are light green and chalky with soft texture.
- Long Grain (Milled Rice)** - Rice grain with 80% or more of whole milled rice grains having a length of 6.0 millimeters and above.
- Medium Grain (Milled Rice)** - Rice grain with 80% or more of whole milled rice grains having a length of 5.0 to 5.9 millimeters.
- Milled Rice** - Grains obtained after removal of hull and bran.
- Moisture Content (as received)** - The water content of palay, milled rice and corn, expressed in % wet basis.
- Moldy Grains** - Grains or pieces of grains which are contaminated with molds.
- Overmilled Rice** - Rice grain from which the hull, the germ and the bran layers have been completely removed.
- Premium Grade** - Any rice and corn variety which meet the highest grade requirements for rice and corn as set forth in the herein prescribed national standards.
- Purity** - Percentage of palay grains free of foreign matter.
- Red Grains** - Grains which have red pericarp.
- Red Streaked Grains** - Grains, whole or broken, having red streaks of the total length of which is one-half or more of the length of the grains.
- Regular milled rice** - Rice grain from which the hull, the germ, the outer bran layers and the greater part of the inner bran layers have been removed but parts of the lengthwise streaks of the bran layers may still, be present of 15% to 40% of the sample grains.

- Standard** - A specification adopted for wide use or repeated utilization. It is the result of standardization effort approved by a recognized authority.
- Short Grain (Milled Rice)** - Rice grain with 80% or more of the whole milled rice grains having a length of less than 5.0 millimeters.
- Shriveled and Immature Grains-** Grains or pieces of grains which are not fully developed, thin and papery in appearance.
- Specification** - A concise statement of a set of requirements to be satisfied by a product, material or a process indicating whenever appropriate, the procedure by means of which it may be determined whether the requirements given are satisfied.
- Size** - Length category of at least 80 percent of the sample of whole brown rice/milled rice to which the sample belongs.
- Traditional Variety** - Refers to *indigenous or native varieties of rice and corn other than fancy rice varieties.*
- Well Milled Rice** - Rice grain from which the hull, the germ, the outer bran layers and the greater part of the inner bran layers have been removed, but parts of the lengthwise streaks of the bran layers may still be present on less than 15% of the sample grains.

#### **Appendix 2.13 — Standard Specifications for Milled Rice of USA**

##### **Components of Rice Quality in the United States**

Hull and bran color  
 Grain characteristics  
 Milling quality  
 Cooking and processing indices  
 Moisture content  
 Test weight  
 Color  
 Dockage  
 Damaged grains  
 Odors  
 Red rice



Source: B.D. Webb. 1985. *In Rice Chemistry and Technology*  
**United States Standards for Milled Rice**

**Terms Defined**

**Definition of milled rice**

Whole or broken kernels of rice (*Oryza sativa* L.) from which the hulls and at least the outer bran layers have been removed and which contain not more than 10.0 percent of seeds, paddy kernels, or foreign material, either singly or combined.

**Definition of other terms**

- (a) **Broken kernels.** Kernels of rice which are less than three-fourths of whole kernels.
- (b) **Brown rice.** Whole or broken kernels of rice from which the hulls have been removed.
- (c) **Chalky kernels.** Whole or broken kernels of rice which are one-half or more chalky.
- (d) **Classes.** There are seven classes of milled rice. The following four classes shall be based on the percentage of whole kernels, and types of rice:

Long Grain Milled Rice  
 Medium Grain Milled Rice  
 Short Grain Milled Rice  
 Mixed Milled Rice

The following three classes shall be on the percentage of whole kernels and of broken kernels of different size:

Second Head Milled Rice  
 Screening Milled Rice  
 Brewers Milled Rice

- (1) "Long grain milled rice" shall consist of milled rice that contains more than 25.0 percent of whole kernels of milled rice and in U.S. Nos. 1 through 4 not more than 10.0 percent of whole or broken kernels of medium or short grain rice. U.S. No. 5 and U.S. No. 6 long grain milled rice shall contain not more than 10.0 percent of whole kernels of medium or short grain milled rice (broken kernels do not apply).
- (2) "Medium grain milled rice" shall consist of milled rice which contains more than 25.0 percent of whole kernels of milled rice and in U.S. Nos. 1 through 4 not more than 10.0 percent of whole or broken kernels of long grain rice or whole kernels of short grain rice. U.S. No. 5 and U.S. No. 6 medium grain milled rice shall contain

not more than 10.0 percent of whole kernels of long or short grain milled rice (broken kernels do not apply).

- (3) "Short grain milled rice" shall consist of milled rice which contains more than 25.0 percent of whole kernels of milled rice and in U.S. Nos. 1 through 4 not more than 10.0 percent of whole or broken kernels of long grain rice or whole kernels of medium grain rice. U.S. No. 5 and U. S. No. 6 short grain milled rice shall contain not more than 10.0 percent of whole kernels of long or medium grain milled rice (broken kernels do not apply).
- (4) "Mixed milled rice" shall consist of milled rice which contains more than 25.0 percent of whole kernels of milled rice and more than 10.0 percent of "other types" as defined in paragraph (i) of this section. U.S. No. 5 and U.S. No. 6 mixed milled rice shall contain than 10.0 percent of whole kernels of "other type" (broken kernels do not apply).
- (5) "Second head milled rice" shall consist of milled rice which, when determined in accordance with 868.303, contains:
  - (i) Not more than (a) 25.0 percent of whole kernels, (b) 7.0 percent of broken kernels removed by a 6 plate, (c) 0.4 percent of broken kernels removed by a 5 plate, and (d) 0.05 percent of broken kernels passing through a 4 sieve (southern production); or
  - (ii) Not more than (a) 25.0 percent of whole kernels and (b) 15.0 percent of broken kernels passing through a 5 ½ sieve; ;and more than (c) 50.0 percent of broken kernels passing through a 6 ½ sieve and (d) 10.0 percent of broken kernels passing through a 6 sieve (western production).
- (6) "Brewers milled rice" shall consist of milled rice which, when determined in accordance with 868.303, contains not ore than 25.0 percent of whole kernels and which does not meet the kernel-size requirements for the class Second Head Milled Rice or Screening Milled Rice.
- (e) **Damaged kernels.** Whole or broken kernels of rice which are distinctly discoloured or damage by water, insects, heat, or any other means, and parboiled

kernels in nonparboiled rice. "Heat-damaged kernels" shall not function as damaged kernels.

**Appendix 2.13.1 — Grades and Grade Requirements for the Classes Long Grain Milled Rice, Medium Grain Milled Rice, Short Grain Milled Rice and Mixed Milled Rice**

Grade	Seeds, heat-damaged, and paddy kernels (singly or combined)			Chalky kernels [1][2]		Broken kernels				Other types [4]			
	Total (number in 500 gram)	Heat-damaged kernels and objectionable sees (number in 500 grams)	Red rice and damaged kernels (singly or combined percent)	In long grain rice (percent)	In medium or short grain rice (percent)	Total (percent)	Removed by a 5 plate [3] (percent)	Removed by a 6 plate [3] (percent)	Through a 6 sieve [3] (percent)	Whole kernels (percent)	Whole and broken kernels (percent)	Colour requirements [1] (percent)	Minimum milling requirements [5]
1	2	1	0.5	1.0	2.0	4.0	0.04	0.1	0.1	--	1.0	Shall be white and creamy	Well milled
2	4	2	1.5	2.0	4.0	7.0	0.06	0.2	0.2	-	2.0	May be slightly gray	Well milled
3	7	5	2.5	4.0	6.0	15.0	0.1	0.8	0.5	-	3.0	May be light gray	Reasonably well milled
4	20	15	4.0	6.0	8.0	25.0	0.4	2.0	0.7	-	5.0	May be gray or slightly rosy	Reasonably well milled
5	30	25	6.0 [5]	10.0	10.0	35.0	0.7	3.0	1.0	10.0	-	May be dark or rosy	Lightly milled
6	75	75	15.0 [6]	15.0	15.0	50.0	1.0	4.0	2.0	10.0	-	May be dark gray or rosy	Lightly milled

**U.S. Sample grade** shall be milled rice of any of these classes which: (a) does not meet the requirements for any of the grades from U. S. No. 1 to U. S. No. 6, inclusive; (b) contains more than 15.0 percent of moisture; (c) is musty or sour, or heating; (d) has any commercially objectionable foreign odor; (e) contains more than 0.1 percent of foreign material; (f) contains two or more live or dead weevils or other insects, insect webbing, or insect-refuse; or (g) is otherwise of distinctly low quality.

**Appendix 2.13.2 — Grades and Grade Requirements for the Class Second Head Milled Rice**

Grade U. S. No.	Total (number in 500 grams)	Maximum limits of Seeds, heat-damaged, and paddy kernels (single or combined)			Color requirements [1]	Minimum milling requirements
		Heat-damaged kernels and objectionable seeds (number in 500 grams)	Red rice damaged kernels (singly or combined) (percent)	Chalky kernels [1] [3] (percent)		
1	15	5	1.0	4.0	Shall be white or creamy	Well milled
2	20	10	2.0	6.0	May be slightly gray	Well milled
3	35	15	3.0	10.0	May be light gray	Reasonably well milled
4	50	25	5.0	15.0	May be gray or slightly rose	Reasonably well milled
5	75	40	10.0	20.0	May be dark gray or rosy	Lightly milled

**U.S. sample grade** shall be milled rice of this class which: (a) does not meet the requirements for any of the grades from U. S. No. 1 to U. S. No. 5, inclusive; (b) contains more than 15.0 percent of moisture; (c) is musty or sour, or heating; (d) has any commercially objectionable foreign odor; (e) contains more than 0.1 percent of foreign material; (f) contains two or more live or dead weevils or other insects, insect webbing, or insect refuse; or (g) is otherwise of distinctly low quality.

**Appendix 2.13.3 — Grades and Grade Requirements for the Class Screening Milled Rice**

Maximum limits of Paddy kernels and seeds					
Grade U.S. No.	Total (singly or combined) (number in 500 grams)	Objectionable seeds (number in 500 grams)	Chalky kernels [1] [3] (percent)	Colour requirements [1]	Minimum milling requirements [2]
1 [4] [5]	30	20	5.0	May be white or creamy	Well milled
2 [4] [5]	75	50	8.0	May be slightly gray	Well milled
3 [4] [5]	125	90	12.0	May be light gray or slightly gray	Reasonable well milled
4 [4] [5]	175	140	20.0	May be gray or rosy	Reasonably well milled
5	250	200	30.0	May be dark gray or very rosy	Lightly milled

**U.S. sample grade** shall be milled rice of this class which: (a) does not meet the requirements for any of the grades from U.S. No. 1 to U.S. No. 5, inclusive; (b) contains more than 15.0 percent of moisture; (c) is musty or sour, or heating; (d) has any commercially objectionable foreign odor; (e) contains more than 0.1 percent of foreign material; (f) contains two or more live or dead weevils or other insects, insect webbing, or insect refuse; or (g) is otherwise of distinctly low quality.

**Appendix 2.13.4 — Grades and Grade Requirements for the Class Brewers Milled Rice**

Grade U.S. No.	Total (singly or combined) (percent)	Maximum limits of Paddy kernels and seeds		
		Objectionable seeds (percent)	Colour requirements [1]	Minimum milling requirements [2]
1 [3][4]	0.5	0.05	Shall be white or creamy	Well milled
2 [3][4]	1.0	0.1	May be slightly gray	Well milled
3 [3][4]	1.5	0.2	May be light gray or slightly rosy	Reasonably well milled
4 [3][4]	3.0	0.4	May be gray or rosy	Reasonably well milled
5	5.0	1.5	May be dark gray or rosy	Lightly milled

**U.S. Sample grade** shall be milled rice of this class which: (a) does not meet the requirements for any of the grades from U.S. No. 1 to U.S. No. 5, inclusive; (b) contains more than 15.0 percent of moisture; (c) is musty or sour, or heating; (d) has any commercially objectionable foreign odor; (e) contains more than 0.1 percent of foreign material; (f) contains two or more live or dead weevils or other insects, insect webbing, or insect refuse; or (g) contains more than 15.0 percent of broken kernels that will pass through a 2 ½ sieve; (h) contains two or more live or dead weevils or other insects, insect webbing or insect refuse; or (i) is otherwise of distinctly low quality.

Appendix 3.0 — The Physical Properties of Aromatic and Fine Varieties of Rice in Bangladesh

Appendix Table 3.1 — Quality of Aromatic Milled Brown Rice from Indian Automatic Rice Mills

Sample no./source	MC (%)	Foreign matter (%)	Whole grain (%)	Head rice (%)	Small broken (%)	Yellow & damaged grain (%)	Chalky & Immature (%)	Paddy no/100g	Other varieties (%)	Red rice (%)	Cracked grain (%)	Variety
23. M/S Kanchan Auto Dinajpur	-	-	-	-	-	0.4	-	-	-	1.6	3.2	Katharibhog (BR)
	-	-	-	-	-	4.5	-	-	-	3.2	5.3	(BR)
	16.9	0.1	91.0	96.0	2.6	0.1	5.1	0.0	2.4	0.0	-	Brwon rice Milled rice
27. M/S H.M Auto, Dinajpur	-	-	-	-	-	2.0	-	-	-	4.2	0.5	Katharibhog (BR) Milled rice
	-	0.0	81.0	94.0	3.0	0.0	4.9	0.0	4.9	0.0	-	(BR) Milled rice
37. M/S Kanchan Auto Dinajpur	-	-	-	-	-	1.5	-	-	-	1.3	18.9	Katharibhog (BR)
	-	0.0	92.3	95.4	2.6	0.0	3.0	0.0	2.0	0.0	-	(BR)
	-	-	-	-	-	1.8	-	-	-	19.8	1.2	Chinigura (BR)
38. M/S N.B.G.I Naogaon	-	0.0	94.0	97.3	2.2	0.0	1.7	0.0	10.0	0.0	-	(BR)
	-	-	-	-	-	2.7	-	-	-	7.1	2.3	Chinigura (MR)
	-	0.2	88.4	95.1	2.5	0.2	3.2	0.0	17.2	0.0	-	(MR)
	-	0.0	92.4	94.5	3.6	1.8	1.1	0.0	5.5	0.0	-	Chinigura (BR)
	-	-	-	-	-	-	-	-	-	-	-	Chinigura (MR)
	-	-	-	-	-	-	-	-	-	-	-	Sarna (MR)

Source: Baqui et al, 1997.



Appendix Table 3.2 — Quality of Aromatic Brown/milled Rice from Chinese Automatic Rice Mills

Sample no./source	MC (%)	Foreign matter (%)	Whole grain (%)	Head rice (%)	Small broken (%)	Yellow & damaged grain (%)	Chalky & Immature (%)	Paddy no/100g	Other varieties (%)	Red rice (%)	Cracked grain (%)	Variety
2. M/S M.M. Rahman R.Mill Sherpur	-	-	-	-	-	1.0	-	-	-	7.3	0.5	BR*
		0.0	93.0	95.0	2.7	0.4	2.9	0.0	14.0	0.0	-	MR*
3. M/S Haji Kalim R.Mill sherpur	-	-	-	-	-	1.8	-	-	-	0.9	0.4	Pajam (BR)
		0.0	86.5	91.0	7.3	1.2	4.1	0.0	1.4	0.0	-	Pajam (MR)
4. M/S Joynul Abedin, Sherpur	-	-	-	-	-	1.7	-	-	-	4.9	1.6	Pajam (BR)
		0.0	77.5	83.5	12.0	0.5	3.4	0.0	1.5	0.0	-	Pajam (MR)
		0.0	88.0	93.0	3.3	0.3	2.1	0.0	2.3	0.0	-	Tulshimala (MR)
15. M/S Kalaikuri Naogaon	12.8	0.0	75.5	77.3	13.6	2.2	11.1	58	3.2	2.7	-	BR 11 (BR)
	-	0.0	62.0	65.5	17.7	2.2	10.1	6	1.4	0.2	-	BR 11 (MR)
21. M/S M.R. R. Mills Dinajpur	16.6	0.0	73.0	78.0	5.0	0.2	3.2	-	2.0	-	-	Katharibhog (MR)
22. M/S M.R. R. mills Dinajpur	-	-	-	-	-	0.2	-	-	-	2.3	1.3	Chingura/Bashabhog (BR)
	17.3	0.0	93.4	96.2	2.3	0.2	1.3	-	4.5	-	-	Milled rice
25. M/S Zobeda Dinajpur	-	-	-	-	-	2.0	-	-	-	1.5	0.9	Brown rice
	-	0.0	86.0	92.0	6.0	0.1	3.5	0.0	0.9	0.0	-	Chinigura (MR)

Note: \* Mixture of Tulshimala, Chinigura and Chinisagar

Source: Baqui et al, 1997.

Appendix Table 3.1 shows the quality of aromatic milled rice from large Indian automatic rice mills. The percentage of wholegrain obtained from large automatic rice mills varies from (77-94%). However, the head rice produced from these mills ranged from 82-97% while the small broken ranged from 2.0-11.4%. A higher percentage (17.2%) of mixtures was found in a sample of the chinigura variety. Other impurities such as foreign matter, damage grain, chalky and cracked grains are negligible.

Appendix Table 3.2 shows the quality of aromatic milled rice from small Chinese automatic rice mills. The percentage of wholegrain of aromatic varieties received from the Chinese automatic rice mills ranges from 78-93% whereas the head rice obtained from Chinese semi automatic rice mills for aromatic varieties ranges from 78-96%. Moisture is higher (16-17%) in samples collected during harvesting time whereas samples collected during Feb-March indicate very low moisture (below 9.0%).

Appendix Table 3.3. shows the quality of aromatic milled rice from Engelberg huller mills. The percentage (79-92%) of whole grain rice obtained from Engelberg huller mills is higher than that obtained from automatic mills. However, percentage head rice yielded by those mills are similar to those obtained from Indian and Chinese rubber roll mills. This is because Engelberg huller mills overdry their paddy below 8-9% and use 2-3 passes through the huller. Small broken is higher (0.8% - 6.8%) for Engelberg steel hullers. Impurities such immature grain, other varieties are found at greater number in rice from small mills than that from automatic mills.

Appendix Table 3.3 — Quality of Aromatic Milled Rice from Engleberg Huller Mills

Sample no./source	MC (%)	Foreign matter (%)	Whole grain (%)	Head rice (%)	Small broken (%)	Yellow & damaged grain (%)	Chalky & Immatured (%)	Paddy no/100g	Other varieties (%)	Red rice (%)	Cracked grain (%)	Variety
10. Custom mill Mymensingh	-	0.0	92.0	95.3	2.5	0.5	1.1	0.0	1.1	0.0	-	Chinigura (MR)
17. Engleberg Naogaon	16.4	0.0	83.2	82.6	5.2	0.0	0.8	0.0	1.6	0.0	-	Kalijira (MR)
	-	0.0	90.7	95.9	3.7	0.2	0.03	3.0	.01	0.0	-	Chinigura (MR)
19. Custom mill Naogaon	11.1	0.1	-	-	-	-	2.7	-	6.9	-	-	Chinigura (BR)
26. M/S Al Mamun Dinajpur	-	0.0	88.7	94.3	6.3	0.0	3.9	0.0	4.6	0.0	-	Chinigura (MR)
28. M/S sankar Dinajpur	-	0.0	90.3	92.0	6.3	1.0	5.1	0.0	8.6	0.0	-	Chinigura (MR)
45. M/S Muzzammel Chapai N.Ganj	-	0.0	91.8	97.7	0.8	0.0	0.0	0.0	8.2	0.0	-	Chinigura (MR)
46. M/S Mr. Afsar Ali Chapai N.Ganj	-	0.2	79.4	86.2	6.8	0.0	2.2	0.0	9.4	0.0	-	Chinigura (MR)
47. M/S Sawkat Ali Chapai N.Ganj	-	0.0	87.9	92.5	6.4	0.0	1.8	0.0	10.2	0.0	-	Chinigura (MR)
48. M/S Sagar Chapai N.Ganj	-	0.0	87.4	94.2	3.5	0.0	0.0	0.0	8.1	0.0	-	Chinigura (MR)

Source: Bequi et al, 1997.

Appendix Table 3.4 — Milling Yields from Aromatic Paddy

Type of mill	Milling yield (%)				
	Chinigura	Kalijira	Katharibhog	Pajam	BR11 (Parboiled)
Large automatic mill	53.4	50	54.8	58.1	66.7
Chinese mini rice mill	55.2	60	56.7	58.3	66.3
Engelberg steel huller	56.5	57.5	60.9	61.6	65.7

Appendix Table 3.5 — Samples of Rice Obtained from Automatic and Chinese Mills During Fieldwork

Grade designation	Foreign matter	Brokens and fragments	Other rice including red grains	Damaged, discoloured and chalky grains	Moisture
Special	0.5	5.0	10.0	1.0	14.0
A (Indian Samples)	1.0	10.0	15.0	2.0	14.0
B (Indian Samples)	2.0	10.0	20.0	3.0	14.0
Bangladeshi Samples					
M/S N. B. Grain Industries (Auto), Naogaon	0.3	3.0	5.0	2.5	13.4
M/S Kanchan Auto, Dinajpur	0	4.5	2.0	3.0	13.0
M/S M. M. Rahman, Mill, Sherpur	0	5.0	14.0	3.3	13.0
M/S Joynul Abedin, Sherpur	0	7.0	2.3	2.4	13.0
M/S Zobeda, Dinajpur	0	8.0	0.9	3.6	13.0
M/S M. R. R. Mills, Dinajpur	0	3.8	4.5	1.5	12.5

Notes: The results show that one sample would make the A category, the others would be B, largely because of higher than permitted levels of damaged and discoloured grains. This indicates that there are already millers producing aromatic rice of an acceptable export quality. This is a positive result, and one that was not expected before.

Source: Baqui, et. al. 1997; Swetman, T. 1997.

Appendix Table 3.6 — Grain Size and Shape of Specialty Rices

Sample	Length	Breadth	Length/Breadth ratio	Classification
Thai fragrant	7.10	1.81	3.92	Extra long/slender
<i>Basmati</i>	7.47	1.66	4.51	Extra long/slender
<i>Chinigura</i>	3.95	1.46	2.70	Short/bold
<i>Katharibhog</i>	5.05	1.60	3.16	Medium/slender
<i>Kalijira</i>	3.85	1.55	2.50	Short/bold

Source: Baqui et. al. 1997

The results indicate that the size/shape of the grain is unlike any currently available in the UK market. *Katharibhog* is the only one of the three that can be classified as a medium grain.

## Appendix Table 5 — Survey Questionnaire

## Questionnaire for Information on Storage and Inspection Procedure at LSD/CSD

1. **Location:**  
Name of Interviewee with designation:
2. **Date of commissioning of (LSD):**
3. **Type of structure:**
4. **Capacity of LSD/CSD:**
5. **Type of commodity in store:**
6. **Source of procurement:**
7. **Standard of procurement and quality at procurement:**

	I	II	III	IV
Moisture content				
Big brokens				
Small brokens				
Chalky, immature, discoloured, red/Un-milled				
Damaged				
Contrasting varieties				
Paddy (grain per kg)				
Foreign matter				
Head rice (min.)				
Milling degree				

8. **Quantity of sample taken:** kg.  
How? (a) Sample auger  (b) Hand pick
9. **If grain is moist, what do you do?**
10. **Storage procedures/label**  
(a) Bag stack  (b) Dunnage  (c) Label  (d) Height ..... m,  
(e) Gap between stack ..... m, (f) Gap between ceiling and top of stack ..... m,  
(g) Distance from side walls ..... m, (h) Other .....
11. **Inspection during storage:**  
How do you sample grain? Describe .....
- (a) What kind of analysis you do?
- (b) Physical change,  
(i) Colour change (ii) Grain dust
- (c) Weight, (d) Hot spot, (e) Insect count,
- (f) Interval of inspection, (g) Rearranging of stack,

(h) Cleaning of storage area : before  after  during

Spider web, dust, stack cleaning

(i) Allowable godown shortage

**12. Disposal indicators and procedures**

- a) determination of disposal time  
 b) determination of disposal quality
- |                  |                          |
|------------------|--------------------------|
| a) Moisture      | <input type="checkbox"/> |
| b) Temperature   | <input type="checkbox"/> |
| c) RH            | <input type="checkbox"/> |
| d) Insect count  | <input type="checkbox"/> |
| e) Odour         | <input type="checkbox"/> |
| f) Colour        | <input type="checkbox"/> |
| g) Chemical test | <input type="checkbox"/> |

**13. Difficulties experienced during implementation**

**14. Opinion for improvement**

**15. Observation of instrumentation facilities of LSD/CSD**

**16. Do you record ambient condition during storage?**

Yes  No

**17. Do you prepare an inspection report?**

Yes  No

**18. Any audit done**

**19. In service – training received**

Yes  If yes, when the training was conducted and where

Regular training  Irregular training

Do you consider this training is enough for performing your daily work?

Name of Interviewer :

Date:

Appendix Table 5.1 — Flow Diagram of Rice Processing

