Chapter 2

REVIEW OF LITERATURE

2.1 Introduction

In this chapter rice of different countries and different varieties are summarised. Traditional as well as computerised methods for evaluation of quality of rice is reviewed and summary of the same is briefed in the last section.

2.2 Literature Review on Iranian Rice

In 2010, authors tried to evaluate the algebraic qualities (size and shape elements) of three Iranian rice assortments as appeared in figure 2.1 at various processing levels by two preparing strategies, namely micrometer method and digital image investigation framework. Correlation of the outcomes got by both strategies demonstrated that the geometric attributes of each of the three types reduces and sphericity increments subsequent to expelling the external and the tanish layers. It was found that the estimations of micrometer information are having lower for all the geometric variables and that the genuine size and sphericity.

In 2009 E. Ghasemi et. al examined textural and morphological properties of cooked rice grains. The enhancements of this system in cooking of three assortments of Iranian rice Sang Tarom, Domsiyah and Fajr were researched. with the utilization of the checking electron microscopy, the external surface of cooked rice stewed by steam had less porosity and nearer pores because of the change amid cooking, and better gelatinization and all the more spreading out of starch granules contrasted with non-stewed samples.
In 2012, S. J. Mousavi Rad tried to choose the best list of capabilities for grouping of rice assortments in light of mass specimens utilizing colonialist rivalry calculation. Highlight choice assumes an essential part in samples. The better choice of a list of capabilities normally comes about the better execution in an arrangement issue. Colonialist rivalry calculation is another transformative enhancement technique that is propelled by settler rivalry[51].

The execution of the proposed calculation was tried for characterization of mass rice tests. The acquired results show the superiority of the proposed calculation to discover better elements leads than high arrangement exactness.

2.3 Literature Review on Korean Rice

In 2011, Choon Young Lee et al. evaluated scholarly classifying strategies for grain utilizing PC vision investigation to classified seven sorts of grain parts including four distinct assortments of Korean Rice, for example, regular rice, glutinous rice, cocoa rice and harsh rice. They were separated based on seven shading elements and ten morphological components[3]. For enhancing effectiveness of the acknowledgment procedure these components were handled by Linear Discriminate Analysis (LDA) which was utilized as an information pre-preparing change and yield of this examination is utilized as contribution to four Back-Proliferation System (BPN) to order diverse grain bit assortments. They additionally analyzed PCA-BPN based calculation. Toward the end of the analysis, they proposed that LDA-BPN strategy has more
Figure 2.2: Images of seven different varieties of rice

noteworthy achievement rate and gave the square outline of proposed strategy as in Figure 2.3[^3]. In 2009, Oliver C. Agustin, Byung-JooOh proposed a programmed assessment strategy for the

![Diagram](image)

Figure 2.3: Proposed strategy for evaluation of rice

nature of processed rice. Shape descriptors decide the amount of head rice, broken portions, and brewers in processed rice tests utilizing six geometric elements. Shading histograms of rice pieces in RGB and Cielab shading channels are utilized to concentrate 24 shading highlights[^2]. A Probabilistic Neural Network system (PNN) is then used to order rice parts as indicated by rice defectives utilizing this shading highlights. The accuracy of the classifier is 94%. Straight relapse model is produced for evaluating singular bit weight given a blob range. They acquired
an extremely encouraging result with a coefficient of determination, R2 of 0.991 between the furthermore, evaluated weight.

The regression model may give off base results when the blob region is not exactly the base edge esteem. The technique for processed rice quality investigation comprises of the steps as shown in Figure 2.4.Stages for the rice quality assessment are processed rice picture procurement, pre-preparing for foundation division, shading blob extraction, characterization of rice parts, evaluating portion weight from blob territories[92].
2.4 Literature Review on Chinese Rice

In 2010, Ai-Guo Ou Yang et al. indicated an agreeable technique for recognizing unique assortment of rice seeds utilizing Machine Vision Technology\[^{53}\]. Figure 2.5 represents varietal rice grains to be analyzed. A programmed technique for distinguishing diverse assortment of rice seeds utilizing machine vision innovation was examined, and a discovery framework which was comprised of a programmed examination machine what's more, an image-processing unit, was likewise created.

Image analysis was completed by Visual C++ 6.0. Shading highlights in RGB (red, green, blue) and shading spaces were registered. A back forward neural system was prepared to recognize rice seeds almost each of the 86.65% rice seeds were accurately distinguished. The right characterization rates for five rice assortments were: No. 5 'Xiaonong' of 99.99%, 'Jinyougui' of 99.93%, 'You166' of 98.89%, No. 3 'Xiaonong' of 82.82% and 'Medium You' of 463 of 86.65%, individually. In light of the outcomes, they inferred that the framework was sufficient to use for assessment of assortments of various rice seeds in light of their appearance characters of seeds.

In 2008, Xu Lizhang et al. evaluated Multi-scale edge recognition calculation of four distinctive assortment of Chinese rice and grouped rice parts with none, single, twofold or numerous anxiety cracks\[^{54}\]. Rice kernels were named those with none, single, twofold or numerous anxiety splits as shown in Figure 2.6.

In 2005, Chang-Chun Liu et al. perceived five aligned models from five paddy rice cultivators developed in Taiwan and collected in the summers of 1997, 1998, and 1999. These models set up by utilizing back proliferation neural system program through various morphological and shading highlights determination for characterizing paddy rice gathered in the summer of 2000\[^{55}\]. Utilizing five paddy rice cultivars (Tainung Sen 20, Taichung Sen 10, Tainung 67,
Taikeng 8, and Taikeng 9) as shown in Figure 2.7 developed in focal, eastern, and southern Taiwan and reaped in the summers of 1997, 1998, and 1999, five aligned models were set up utilizing four distinct components.

Model 1 and Model 5 had 60 highlights. By stacking in PC1, Model 2 had 50 highlights. From the relationship coefficient grid thirty-five components were chosen for Model 3. Based on the commitment from the preparation model, Model 4 had 20 highlights. The normal acceptance rates for Models 1 to 5 were 92.2% (with 4.8% standard deviation); 91.8% (5.3%); 89.9% (6.3%); 90.6% (6.1%); and 94.6% (6.0%), individually. In light of the three-year model, which was utilized to arrange the fourth year tests, the normal order rates for Models 1 to 5 were 92% (with 11.0% standard deviation); 90.0% (19.7%); 91.0% (13.4%); 91.8% (15.7%); and 99.8% (0.5%) individually.

Programming for Neural Works Professional II/PLUS (Neural Ware, Carnegie, PA) was second-hand for preparing, accepting, and grouping tests utilizing the back engendering neural system program and from this Model 4 was viewed as the best model for ordering these five cultivars since it required less components and held a steady arrangement rate as it changed...
from 10 to 55 highlights \cite{55}.

In 2005, LIU Zhao-yan, CHENG Fang, YING Yi-receptacle and RAO Xiu-qin created computerized image examination calculation in view of shading and morphological components to recognize the six assortments (ey7954, syz3, xs11, xy5968, xy9308, z903) rice seeds which are broadly planted in Zhejiang Province as in figure 2.8. Seven hues and fourteen morphological elements were utilized for discriminant examination.

Two hundred and forty pieces utilized as the preparation information set and sixty parts as the test information set in the neural system used to distinguish rice seed assortments. Four important segments were gotten after Principal Component Analysis. A two-layer tansigmoid/log-sigmoid system was utilized to group the rice seed. At the point when the model was tried on the test information set, the distinguishing proof were 90.00%, 88.00%, 95.00%, 82.00%, 74.00%, 80.00% for ey7954, syz3, xs11, xy5968, xy9308, z903 individually \cite{48}.

2.5 Literature Review on Philippine Rice

In 2008, Jose D Guzman et al proposed the utilization of a machine vision framework and neural systems for programmed distinguishing proof of the sizes, shapes, and assortment of tests of 52 rice grains having a place with five varietal gatherings of rice in the Philippines. The system for analysis is as shown in Figure 2.9. The paper introduces the order exactness of the sizes, shapes and varietal sorts of rice prevalently developed in the Philippines utilizing multilayer neural systems. Morphological components were separated utilizing machine vision and example acknowledgment from an individual grain picture. The thirteen grain elements
were separated. A few multilayer neural systems were created for sizes, shapes and varietal sorts grouping. Morphological elements separated from every specimen picture can be utilized as info variables to Multilayer Neural Network topologies to perceive and arrange coarse rice sizes, shapes, and varietal sorts at general normal correctness of 98.76% and 96.67%, individually [56]. A normal general exactness of around 70 percent was acquired when the example pictures of

![Figure 2.9: Suggested system for analysis](image)

the 52 assortments were incorporated into the gathering arrangement.

### 2.6 Literature Review on Thai Rice

In 2006 S.Sansomboonsuk et.al built up the suitable calculations of Image examination for Thai jasmine rice piece quality and a computer vision framework was created for assessing the nature of rice parts and used to concentrate highlights for touching portions. The touching bit highlights comprise of two types of touching: point and line touching bits. The shrinkage operation are utilized to separate touching components and Object acknowledgments are utilized for the line touching feature[57]. Figure 2.10 shows the original and edge detected image of rice samples.

In 2008, Siriluk Sansomboonsuk et.al assessed the nature of three assortments of Thailand paddy (sifted, unmilled rice), rice test having distinctive translucency level, Jasmine rice, white rice and glutinous rice. The picture examination calculations are created for checking the nature of rice part that is rate of broken rice and rate of the immaculateness of rice as appeared in Figure 2.11 (a) and (b).
They gauged and ascertained range, border, circularity and shape minimization as criteria in Fuzzy logic for grouping every piece. From testing the picture investigation calculations they discovered exactness averaging 92% for both of the broken rice and the virtue of rice contrasted and human assessment. In finding the rate of broken rice, picture is gained from front lighting system. In this study, picture examination gives 92.22% rightness. The backdrop illumination strategy is utilized for after effects of screening the diverse assortment of rice taking into account the translucency. For this situation the principle key purpose of the achievement is picture examination gives 94.97% exactness \[58\].
2.7 Literature Review on Indian Rice

In 2010, Sanjivani Shantaiya and Uzma Ansari manages a way to deal with perform texture and morphological construct recovery in light of a corpus of nourishment grain pictures. The work has been done utilizing Image Warping and Image examination approach. The technique has been employed to standardize nourishment grain images and subsequently taking out the impacts of twisting system with appropriate scaling. The images have been appropriately upgraded to diminish noise and obscuring in image. At last image has been portioned applying legitimate segmentation strategies with the goal that edges might be distinguished successfully and subsequently correction of the image has been finished. The methodology has been tried on adequate number of nourishment grain images of rice in view of force, position and introduction. An advanced image analysis calculation in view of shading, morphological and textural components was created to recognize the six assortments rice seeds which are generally planted in Chhattisgarh area as shown in Figure 2.12. Nine shading and nine morphological and textural components were utilized for discriminant examination.

A neural system was utilized to characterize the rice seed. In the test dataset, the arrange-

![Figure 2.12: Poornima Rice variety for analysis](image)

ment exactness 's were 90.00%, 88.00%, 95.00%, 82.00%, 74.00%, 80.00% individually. In 2010, Bhupinder Verma created Image Processing Techniques for Grading and Classification of three distinctive Indian rice assortments self-loader FBS procedure. A generally speedier PC vision framework has been examined to break down and sort rice portions. A progression of estimations were done utilizing picture handling strategies on three assortments of Indian rice to be specific Markfed Supreme, Markfed Golden (fare quality), Hafed Basmati as in Figure
2.13. Range, border, most extreme length, greatest width, smallness and prolongation were measured. Further, isolating the rice assortments by their shape distinction was inspected.

The computer vision framework created has possessed the capacity to sort rice into sound, broke, pasty, broken and harmed parts with a precision going from 90-95%. In this study a self-loader FBS methodology for order and reviewing of three Indian assortments of rice was produced. The exploratory setup included Flatbed Scanner 11x9 inch 300 dpi with USB interface to a PC with 128 MB RAM as equipment and MS - ACCESS as database, Visual Basic as Development Language and Matrox Imaging and Neuro Solutions Libraries. Rice bits of three Indian assortments to be specific; Markfed Supreme, Marfed Golden and Hafed were taken up for evaluating and arrangement. The fundamental strides in the grouping and reviewing of rice are as per the following:

- Filtering the specimen part.
- Picture handling.
- Parameter extraction.
- Reviewing of rice piece.
- Order of rice piece.

In 2012, S. F. Lilhare and Dr N G Bawane present the order strategy for different paddy assortments according to the rice handling prerequisite. In first stage four morphological elements of the individual as well as groups average features of paddy were removed utilizing
image processing[61]. Out of these four components just two elements (minor pivot what’s more, range) are giving adequate data to group the paddy according to the necessity of rice dryer and preparing plant. In the second stage a food forward neural system was connected to characterize the removed information. Another 10 sets of tests were tried utilizing NN and it is found that all these tests are arranged appropriately.

The two layer bolster forward neural system model as appeared in figure 2.14 with 5 neuron

![Two Layer Neural Network](image)

Figure 2.14: Two Layer Neural Network

in every layer is utilized for classification as shown in figure 2.14. The preparation of the NN was performed utilizing 100 specimens and after that it is tried utilizing arbitrary seeds of various quality in mass with normal components. For preparing and accepting the NN, images were partitioned into three preparing sets i.e. expansive quality, Mid-range quality and Small quality by considering the zone and minor hub[61].

In 2015 Vidya Patil et al suggested image processing technique to automate the process which overcomes the drawback of manual process. They provide the concept of quality assessment of rice grain based on its size. It gives the number based on the size of grain like grade 1, grade 2, grade 3 etc. Here they considered different varieties of rice grains for testing like Basmati, sonamasuri, boiled rice, egg rice etc. The system is developed using 105 set of images and are classified using decision based classification tree. The result to be found was encouraging. They referred food grain grading, extraction, morphological operation, quality analysis. Unfortunately soft computing techniques for measurement of accuracy was not incorporated neither the whole process was automatic nor the system for evaluation was well developed.

In 2016 Sheetal Mahajan, et al proposed solution of quality analysis of Indian Basmati rice grain using Top Hat Transformation. In this paper the problem of Non uniform, illumination for quality assessment is defined which show their effects in the process of extracting object
from the background and cause segmentation errors. This proposed method achieves high
degree of accuracy in correcting the effects of non-uniform illumination than computer vision
inspection. This proposed method is based on Morphological features is developed for counting
the number of Indian Basmati rice grain with Normal grains, Long grains and small grains.
The work mainly centres towards Basmati rice grains and other Non Basmati rice varieties
were not evaluated during the research by the authors [63].
B.S. Anami, et al., (2015), proposed a method for recognition of paddy varieties from bulk
paddy grain image samples based on color texture features extracted from color co-occurrence
matrices. The color texture features are extracted from H, S and I color planes and their
combinations. The color texture features are used for recognition of 15 paddy varieties. The
reduced feature set of the HS plane includes Energy, Entropy and Correlation features from
Hue plane and Energy, Entropy, Contrast, and Correlation features from Saturation plane. The
paddy grain images are recognized using a multilayer feed forward artificial neural network.
The considered fifteen paddy varieties have given the recognition accuracy of 92.33% [64].
Neelam et al., (2015), proposed the computer vision system, designed for identification and
classification purpose. In this, training algorithm was based on using Levenberg Marquardt
and performance is based on the mean square error. The network was trained, validated, tested
on given parameters with accuracy approximately 89.7% [14].

2.8 Summary of Literature Review

- The research work gives a clear idea of quality evaluation of rice whether processed (after
  milling) or unprocessed (before going to rice mill) in various Asian sub-continent but
  non basmati Indian rice varieties are still unevaluated.

- The research work gives a major classification based on color parameter or morphological
  features. Need of combined measurement techniques for non basmati Indian rice varieties
  is the need of the hour.

- The data mining techniques used up till now are specific to the respective rice varieties
  of various countries and cannot be implemented in our case.

- Occlusion/touching kernels is a general problem being faced up till now. Image segmen-
tation/Post processing technique for extracting feature would play a crucial role for the evaluation purpose.

- A design framework is not available for the benefit of consumer and distributor to evaluate the commonly consumed rice varieties (non basmati)