**Chapter II**

**REVIEW OF LITERATURE**

This chapter supplies necessary compiled information gathered from books, journals, magazines, handbooks, and internet sites credited by experts in order to provide support to this research study. This chapter will aid the readers to have a background about the designed machine and its importance in the field of specific industries.

**RELATED LITERATURE**

**Rice Crop**

As defined by Britannica, the rice crop or rice plant is an annual grass and grows around 1.2 meters (4 feet) in height. It has long and flattened leaves and is borne on hollow stems. Its panicle or flower cluster is composed of spikelets bearing flowers that produced the fruit or grain. The plant’s fibrous root system is often broad and spreading. Differences of a given plant vary from the length, shape, and weight of the panicle, along with its overall productivity.

In an article from Global Yield Cap Atlas, in Southeast Asian countries like Vietnam, Thailand, Myanmar, Philippines, and Cambodia the total annual production and harvested area are around 128.5 Mt and 32.0 M ha, which accounts for 17% global production and 20% harvested area (FAOSTAT, 2020). Among these numbers, the Philippines ranked eighth in world rice production with an annual average yield of 3.96 t which accounts for a total harvested area of ca. 4.7 M.

**Paddy Rice**

According to Feedipedia, rough rice, also known as paddy rice, is the full grain of rice with the hulls (about 20% of the grain) (Ffoulkes, 1998). Brown rice, which is rice without the hulls but still contains the bran, and polished rice, which is rice without the bran, are coarser products. Paddy rice is far less commonly utilized for animal feed than other grains, owing to its higher cost and scarcity. Due to its higher fibre content, it also has a lesser nutritious value. However, throughout the latter decades of the twentieth century, a renewed interest in the use of rice grain as a livestock feed was sparked by a general fall in per capita rice consumption, particularly in middle and high-income Asian nations such as Korea and Japan. Feed rice cultivation was encouraged in the 2000s, for example in Japan, where feed rice types (such as Momiroman) are available (Maruyama et al., 2005; Inoue et al., 2012; Sittiya et al., 2011).

<https://www.feedipedia.org/node/226>

**Seed Selection**

TNAU Agritech Portal: Organic Farming states that paddy cultivation depends heavily on seed selection. The seeds used for cultivation should be homogeneous in size, age, and contamination-free. They should also be able to germinate well. To distinguish between good and poor seeds, immerse them in water; the unviable seeds will float to the surface. These seeds may simply be removed, and the seeds that sink can be planted. Damaged seeds can be easily removed using this procedure. When there is a surplus of chaffy grain in the seed stock, another approach is used. Fill a vessel halfway with water and crack an egg into it. Gradually add salt until the egg reaches the surface. The good quality seeds will sink when they are dropped into water. Remove any seeds that float on the surface of the water that aren't viable. To eliminate salt deposits, wash the selected seeds 2–3 times in clean water. If this is not done, the seeds' ability to germinate will be harmed.

<https://agritech.tnau.ac.in/org_farm/orgfarm_prac_agri_paddy_seed.html>

**Seedbed Preparation**

Based on Rice Knowledge Bank, seedlings must be nurtured in a nursery before being transplanted. Seedling nurseries often take about 5-10% of total farmland. Consider the availability of sunlight, water, labour, land, and agricultural instruments while selecting a nursing system.Cover the seedbed with a layer of burned rice husk or compost, about 1 centimetre thick. Pre-germinated seeds should be sown on the seedbed. Maintain a seed thickness of 56. (1 kg per 1.5 m2). After sowing the seeds, moisten them and then press them down with your hand or a wooden flat board.

<http://www.knowledgebank.irri.org/step-by-step-production/growth/planting/how-to-prepare-the-seedlings-for-transplanting#:~:text=Cover%20the%20seedbed%20with%20about,with%20a%20wooden%20flat%20board>

**Land Preparation**

The soil should be in the optimal physical condition for crop growth and the soil surface should be level before rice can be planted. Plowing and harrowing are used to 'till' or dig up the soil, mix it, and level it. Tillage helps weed control while also allowing seeds to be placed at the proper depth. Farmers can till the land using hoes and other equipment, or with the help of draft animals such as buffalo, tractors, and other machinery. The area is next leveled to prevent water from being wasted due to irregular pockets of too-deep water or exposed soil. Effective soil leveling makes it easier for seedlings to establish themselves, minimizes the amount of effort needed to manage the crop, and improves grain quality and yields (Ricepedia: The Online Authority on Rice).

<https://ricepedia.org/rice-as-a-crop/how-is-rice-grown>

**Transplanting**

As stated on Ricepedia: The Online Authority on Rice, transplanting is the most common method of plant establishment in Asia. Seedlings are transplanted from a seedbed to a wet field once they have germinated. It uses less seed and is a more effective weed control strategy, but it also necessitates more labor. Seedlings can be transplanted by hand or by machine.

<https://ricepedia.org/rice-as-a-crop/how-is-rice-grown>

**Weeding**

According to Rice Production (Peace Corps), in Sierra Leone, weeds are the most common cause of crop failure. Weeds are described simply as "plants out of place," but this definition can be enlarged to include any plants that interfere with the cultivation of desirable plants, create economic loss through increased production costs, or lower crop yield and/or quality. Weeds in irrigated rice can be controlled with a variety of management measures, including the application of herbicides. In Sierra Leone, the majority of weed management is accomplished by non-chemical methods, which, while labor consuming, can be quite effective.

<http://www.nzdl.org/cgi-bin/library?e=d-00000-00---off-0fnl2%2E2--00-0----0-10-0---0---0direct-10---4-------0-1l--11-en-50---20-about---00-0-1-00-0-0-11----0-0-&a=d&c=fnl2.2&cl=CL3.50&d=HASH01cec7731fd065d232caf593.18>

**Fertilizing**

Chemical fertilizers are used heavily in rice farming. Chemical nitrogen (N) fertilizer use in agriculture has expanded ninefold since 1960, while P fertilizer use has climbed threefold, degrading soil health and contaminating the environment. Chemical fertilizers play a significant effect on rice yield. Only 59–69 percent, however when combined with organic nutrition sources, it can improve rice grain yield and soil carbon storage. When compared to chemical fertilizers alone, organic and inorganic nutrients result in yield increases of 0.78 percent to 117 percent.

Biofertilizers combined with 50% less nitrogen (N) and phosphorus (P) resulted in a 32 percent higher rice production than chemical fertilizers. In rice, diazotrophs can contribute as much as 50–120 kg/N/ha to N nutrition. Microorganisms that dissolve phosphate boost P bioavailability. Green manuring rice using Sesbania improves soil carbon status and increases production by 9%–11% over chemical fertilizers, demonstrating that it is a viable organic rice farming option. In the future, sustainable and environmentally friendly rice cultivation will rely on a combination of inorganic and bioorganic fertilizers.

<https://www.sciencedirect.com/science/article/pii/B9780128132722000094>

**Pest Management**

**Harvesting**

The process of collecting the mature rice crop from the field is known as harvesting. A rice crop typically matures between 105 and 150 days after planting, depending on the type. Cutting, stacking, handling, threshing, cleaning, and transportation are all part of the harvesting process. Harvesting techniques that optimize grain production while minimizing grain damage and decay are important.

<https://ricepedia.org/rice-as-a-crop/how-is-rice-grown>

**Threshing**

Traditional Treshing

Rice is traditionally threshed by hand, with panicles being hammered against a hard surface (such as a wooden bar, bamboo table, or stone) or with a flail. Depending on the rice type and method used, outputs range from 10g to 30kg of grain every man-hour. Grain losses range from 1-2 percent to up to 4% when threshing is done too late; some unthreshed grains can also be lost near the threshing location.

Mechanized Treshing

Threshing activities were mechanized earlier than harvesting methods in history, and they were examined throughout the 18th century. Because stalks and ears move through the machine, Western-style threshers are called as 'through-flow' threshers. They include a threshing system with pegs, teeth, or loops, as well as a cleaning-winnowing mechanism based on shakers, sieves, and a centrifugal fan (in more complex variants). Models from European manufacturers (such as Alvan Blanch, Vicon, and Borga) or tropical countries (such as Brazil, India, and others) have capacity ranging from 500 to 2000kg per hour. IRRI invented an axial flow thresher in the 1970s, which has been widely manufactured locally.

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<https://www.fao.org/3/t1838e/T1838E0p.htm>

**Drying**

The purpose of rice drying is to lower the moisture content of the rice to achieve the acceptable values for long-term storage safety. Rice should be dried promptly in bins to a moisture level of about 12% to avoid quality damage. In bins, rice can be dried by blowing enormous amounts of dry air across the grain. This website will look at the difficulties of rice drying and storage, as well as providing the necessary spreadsheets to assist farmers in maintaining rice quality and lowering drying and storage expenses.

<https://www.uaex.uada.edu/farm-ranch/crops-commercial-horticulture/Grain_drying_and_storage/rice_drying_and_storage.aspx>

**Marketing**

In most of Asia, as well as many other regions of the world, the price of rice is a crucial variable for farmers, consumers, and governments. Although the world market price of rice has decreased over time, farmers and consumers are more concerned with domestic costs. The domestic price of rice varies greatly between nations, with some – such as Japan, Korea, Turkmenistan, and Brunei – having domestic costs that are at least seven times higher than the median price of $239 per ton. Higher domestic pricing are linked to higher GDP per capita and higher import proportions in domestic consumption.

<https://ricepedia.org/rice-as-commodity/national-rice-markets>

**Nutritional Value of Rice**

Compared to maize, wheat, and potatoes, raw, long-grain white rice is a comparatively good source of energy, carbohydrates, calcium, iron, thiamin, pantothenic acid, folate, and vitamin E. It lacks vitamin C, vitamin A, beta-carotene, and lutein+zeazanthin, as well as a significant amount of fiber.

Brown rice keeps the bran layer (which contains numerous vitamins and minerals as well as fiber) since it is not polished away to make white rice. Red rice is abundant in iron and zinc, whereas black and purple rices are particularly high in protein, fat, and crude fiber. Anthoncyanin pigments, which are recognized for their free-radical-scavenging and antioxidant properties, as well as other health advantages, give red, black, and purple rice their color.

The calorie content of 1 cup of cooked rice varies from a high of 241.8 kcals for medium-or short-grain white rice, to 218.4 kcals for medium-grain brown rice, 216.5 kcals for long-grain brown rice, 205.4 kcals for regular long-grain white rice, to a low of 165.6 kcals for ‘wild rice’.

<https://ricepedia.org/rice-as-food/nutritional-content>

**Medicinal Value of Rice**

Rice's medicinal characteristics are used in Ayurveda and Unani healing systems in India. Rice has long been used to treat high blood pressure, bodily balance, digestive system issues, diarrhoea in children, skin inflammation, blood sugar regulation, and a variety of other ailments.

A wild rice plant named Nivara is used to treat haematuria, according to the Charaka Samhita (Ray and Gupta,1965). Tandula is a popular rejuvenation and vitalizer herb. The mother is offered kappa kar rice throughout the seventh or ninth month of pregnancy to lower the risk of anemia. Some West Bengal rice varieties, such as Bhat moori, promote blood circulation, Parmai-sal boosts our strength, and Kabiraj-sal helps convalescing people recover faster.

<https://www.ijcmas.com/8-10-2019/R.%20Pushpam,%20et%20al.pdf>

**Solar Panel**

The sun is the source of solar energy. Solar panels (also known as "PV panels") convert sunlight, which is made up of energy-bearing particles known as "photons," into electricity that may be utilized to power electrical loads. Solar panels can be used for a variety of purposes, including remote power systems for cabins, telecommunications equipment, remote sensing, and, of course, electricity generation by residential and commercial solar electric systems.

<https://www.mrsolar.com/what-is-a-solar-panel/>

**Shaft**

A shaft is a mechanical component with a circular cross-section in most cases. It's a device that rotates to transmit power. It serves as a rotational axis for a number of mechanical components such as sprockets, gears, pulleys, flywheels, and cams that are attached to it. Finally, while rotating, it is used to control the geometry of their motion. A shaft should not be confused with an axle, which is a nonrotating element that does not carry torque and is used to support wheels and other spinning objects. An car axle is not a genuine axle, but rather a shaft by definition. To analyze a genuine axle, all you have to do is look at it as a static beam and do a static analysis on it. A shaft, on the other hand, will need to be subjected to a dynamic study to assess fatigue stress.

<https://sbainvent.com/mechanical-design/mechanical-design-of-a-shaft/>

**Crankshaft**

The reciprocating action of the pistons causes the crankshaft to rotate in a reciprocating engine. The piston of a pump, on the other hand, moves back and forth due to the motion of the crankshaft. The pistons are joined to the crankshaft by "crankpins," which have an offset axis, allowing for this motion transfer. Because the reciprocating engine's common four-stroke cycle isn't continuous, the crankshaft is frequently attached to a flywheel that stores rotational energy to lessen the pulsation or choppiness of the pistons.

<https://energyeducation.ca/encyclopedia/Crankshaft>

**V-belt Pulley**

V-belt pulleys (also known as vee belt sheaves) are devices that use a v-belt, a mechanical linkage having a trapezoidal cross-section, to convey power between axles. These components work together to provide a slipping- and misalignment-resistant high-speed power transmission solution. The main purpose of V-belt pulleys is to transmit power between two parallel axels. The geometry of the groove or grooves placed around the circle of the pulley, which guide and obtain traction on a v-belt, is the most apparent difference between a v-belt pulley and other types of pulleys (round belt, flat, etc.). The accompanying video provides an in-depth look at the basics of v-belts, as well as their benefits and variations.

<https://www.globalspec.com/learnmore/motion_controls/power_transmission_mechanical/v_belt_pulleys>

**Battery**

Battery Energy Storage (BES) can help Europe make the transition to a more sustainable and secure energy system based on renewables, reducing greenhouse gas emissions and increasing energy independence. In central, decentralized, and off-grid circumstances, batteries can store energy from on-peak renewable energy and release it when it is needed most. Grid support services such as voltage management and frequency regulation can be provided by batteries, ensuring grid stability and flexibility. Overall, batteries have the potential to increase Europe's renewable energy use, as well as its energy efficiency, sustainability, independence, and security.

<https://www.eurobat.org/batteries-contribution/battery-energy-storage>

**Motor**

In order to create motion, electric motors convert electrical energy to mechanical energy. The interaction of a magnetic field with winding alternating (AC) or direct (DC) current generates force within the motor. The magnetic field rises in strength as the current strength increases. Electric motors have a wide range of uses. Blowers, machine and power tools, fans, and pumps are all common industrial applications. Motors are commonly used by hobbyists in small applications that require movement, such as robotics or modules with wheels.

<https://www.jameco.com/Jameco/workshop/ProductNews/motor-buyers-guide.html>

**Prototype**

A prototype is a first version of a product that demonstrates the fundamentals of what the product will look like, what it will do, and how it will work. A prototype isn't supposed to be the final product; it's more of a rough draft. Even while the prototype may not have the functionality that the final product will have after it is properly made, it will often feature elements that indicate how the product will work. While the item is still in concept stage, the prototype allows you to get a good picture of what the product will be like and make changes.

<https://study.com/academy/lesson/what-is-a-prototype-definition-function-theory.html>

**Welding**

Welding is a method of uniting metal pieces by applying heat. Attempts to mold iron into usable shapes led to the discovery of this method. The first millennium CE saw the development of welded blades, the most famous of which were made by Arab armourers in Damascus, Syria. Although the method of carburizing iron to generate hard steel was known at the time, the resulting steel was extremely fragile. The welding technique, which entailed interlayering relatively soft and durable iron with high-carbon material, then hammer forging, resulted in a strong, tough blade.welding, a technique for combining metallic parts by applying heat. Although the method of carburizing iron to generate hard steel was known at the time, the resulting steel was extremely fragile.

<https://www.britannica.com/technology/welding>

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