EFFICIENCY IMPROVEMENT OF AN AXIAL FLOW PROPELLER PUMP INSTALLED AT KADUMPATTUPADAM KOLE PADAVU, THRISSUR

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PROJECT REPORT

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DECLARATION

We hereby declare that this project entitled **EFFICIENCY IMPROVEMENT OF AN AXIAL FLOW PROPELLER PUMP INSTALLED AT KADUMPATTUPADAM KOLE PADAVU, THRISSUR**is a bonafide record of project work done by us during the course of project and the report has not previously formed the basis for the awardto us for any degree, diploma, associateship, fellowship or other similar title of any other university or society.

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CERTIFICATE

Certified that this project report entitled **EFFICIENCY IMPROVEMENT OF AN AXIAL FLOW PROPELLER PUMP INSTALLED AT KADUMPATTUPADAM KOLE PADAVU, THRISSUR** is a record of project work done independently by Ms. Ayisha Mangat, Sri. Nithin J.G and Ms.Saranya R.Nath , under my guidance and supervision and that it has not previously formed the basis forthe award of any degree, diploma, fellowship or associateship to them.

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AyishaMangat

Nithin. J. G.

Saranya. R. Nath

Dedicated

to

kole land farmers

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SYMBOLS AND ABBREVATIONS

/	per
%	percent
^{0}c	degree celsius
deg.	degree
A	Ampere
et al	and others
cm	centimeter
m	metre
mm	millimeter
ha	hectare
lps	litre per second
s	seconds
V	volts
MSL	mean sea level
hp	horse power
MU	million units
E	east
N	north
kW	kilowatt
ὴ	efficiency
&	and

Introduction

Chapter I

Introduction

The Kuttanad and Kole lands of Kerala are the low lying areas subject to flooding during rainy season mainly due to inadequate drainage facilities. By early twentieth century, the 'Petti and Para' pumping system was introduced for the dewatering operations in these lands, which revolutionized the drainage pumping system of the area. Different models of 'Petti and Para pumping systems' are available which are inefficient and require continuous repair and maintenance. Hence, highly efficient pumps for dewatering are necessary and need of the hour.especially due to the severe scarcity and high cost of electric power.

The Kole wetlands cover an area of about 13,632 hectares spread over Thrissur district and Malappuram district. The area extends from Chalakudy river in South to Bharathapuzha river in the North, and to Ponnani Taluk. The Kole wetlands acts as natural drainage system for Thrissur city and Thrissur district through a network of canals and ponds which connects different parts of Kole wastelands to river and then to the Arabian sea. It is fertile with Alluvium soil which is deposited by Kechery and Karuvannoor river in the monsoon. Agriculture is the major occupation of the people of Kole wet land and ninety percent of people are practicing mostly paddy cultivation. Weeds are major constraint for higher productivity in rice.

Rice production in the coastal regions of Kerala is greatly influenced by appropriate water management practices, especially the drainage requirement. The peculiar feature of paddy cultivation in these regions is the system of drainage of water from the bunded rice fields during the crop season. In Kerala low land paddy cultivation is practiced in Kuttanad, Kole, Pokkali and kaipad lands which lie below MSL. Kole lands, located in the central Kerala are considered as the rice granaries of Kerala. These lands are reclaimed from the *Kayal* (lake) area by constructing temporary ring bunds around and draining the area during summer months using locally made high discharge low head pumps known as 'chakra's. The water in these fields is drained into the Arabian sea. The Kole lands extends in an area of 13631.50 ha in Thrissur district and 3445 ha in Malappuram district respectively known as Thrissur and Ponnani kole areas of the state. The topography of these lands are like a saucer lies 0.50 to 1.50 m below the

MSL. A unique feature of wetland is that they are often located between dry terrestrial systems and permanent deep water systems like rivers, lakes or oceans. Wetlands are important eco systems in the world due to its high content of nutrients and a favourable atmosphere for fish culture.

Introduction of the locally made propeller pump, known as Petti and Para, had revolutionized the drainage pumping of the region in the early twentieth century. Petti and Para is a traditional dewatering pumping system manufactured by local blacksmiths and carpenters. It is a special pump driven by a heavy electric motor of 25 to 100 horse power and discharges water with high flow rate, against low heads. Petti and Para is originally designed by Mr. George Brendon, a British engineer in 1918 by using locally available materials. The pump is connected to the motor using a long belt. Its efficiency is less than 25 per cent.

The scarcity of labours to handle the heavy and bulky ‘petti and para’ is also a challenging problem seriously faced by the kole land farmers. Hence more and more farmers are deviating from the agricultural works in kole lands. A petty and para is normally designed to discharge the water at a height of one meter. Whenever water level in the canal rises above the discharge port of the petti, it could not deliver water against the head of water raised in the canal. This is a common problem experienced by the Kole land farmers.In such situations, the motor will keep running for hours continuously without producing even 25 per cent of its indented efficiency, there by wasting huge amount of electricity per annuam. The ‘petti & para’ hence fitted at a higher level and as the water level lowers, the the pump has to be dismantled and lowered for its working. Operating a petty and para pumping system is very unsafe, hazardous and crude manner with long flat belt and improper wooden support. This crude and laborious methods always tend to suffer damages to the pump as well as the life of the operator working on it besides, financial burden and time loss. On continuous use, it become obsolete due to manufacturing defects and deformation take place, which further contribute for considerable efficiency losses. The commercially available dewatering pumps are having more than 45 per cent efficiency and have high discharge at low heads, which are considered double the efficiency of a traditional petty and para. These types of pumps ensure saving in electricity charges, labour cost for loading, unloading and transporting the pump from the store house to the pumping station.

It is estimated that about 800 petty - para pumps are working in Thrissur and Ponnani Kole lands of the State. Hence the total installed capacity of the petty and para pumping units in these Kole area alone comes around 16.78 MW. It is estimated that a total of 18 million units (MU) of electricity is required to operate these pumps for a period of six months per year. According to the present KSEB subsidized rate (Re. 0.55 per unit) for paddy cultivation, a total amount of Rs. 1 Crore (approx.) is spending per year (of 6 month) by the Govt. of Kerala. If these pumps are replaced with axial flow propeller pumps, it is expected that 70 per cent of cost for electricity can be reduced by way of reducing the electric power consumption from 18 MU to 54.38 lakh units.If the requirement at Kuttanad of Alappuzha district, is added with the kole land requirement ,the advantages and net saving of electricity power and charge will be exorbitantly high. In this context, it is the high time to replace low efficient and high power consumed petty and para pumps with high efficient and low power consumed axial flow pumps at the rice bowls of Kuttanad and Kole lands of the state.

An axial flow propeller pump was installed as an alternative to petti and para at the Kadumpattupadam kole padavu as a part of a research project ‘DIFM package for Kerala’ of the college. The performance of the pump needs to be found out and compared with the conventional petti and para, prevalent in these kole lands. Studies are also to be carried out with different types impellers and diffuser assemblies to find the most suitable assembly for improving the efficiency and discharge under varying load and head conditions. With these factors in view, the following are the objectives of the study.

1. To study the axial flow propeller pump installed at Kadumpattupadam kole padavu,

   Karalam,Thrissur

2. To conduct the performance tests by regulating the inflow at the site.

3. To test the pump with modified impellers and diffuser assembly.

4. To develop a lab model of the pump and its testing.

Review of literature

Chapter II

Review of literature

This chapter describes the location, topography, climate and geographical features of the study area and various research works on ‘petti and para’ and axial flow propeller pump.

2.1 Location

The Vembanad kole wetland ecosystem of Kerala comprising of 15,125 ha is fed by ten rivers. All these rivers originate from Western Ghats, flow westwards and join the Arabian Sea. The area is also exposed to diurnal tidal cycles. The west coast of Kerala is remarkable for the presence of a string of backwaters, estuaries and lagoon barrier complexes. The Kole lands extend from the northern bank of Chalakudy River in the south to the southern bank of Bharatapuzha River in the north. Kole lands are located between 100 20 N and 100 40 N latitude and 75058 E and 76011 E longitude. These fields are geographically distributed in Mukundapuram, Chavakkad and Thrissur taluks of Thrissur district and PonnaniTaluk of Malappuram district. The area from Velukkara in the south on the Chalakudy River bank in MukundapuramTaluk to Mullassery of ChavakkadTaluk and Tholur-Kaiparama areas of Thrissur taluk is designated as ‘Thrissur Kole’ and the contiguous area from Chavakkad and Choondal to Thavanur, covering Chavakkad and Thalapallytaluks of Thrissur district and PonnaniTaluk of Malappuram district form the ‘Ponnani Kole’.

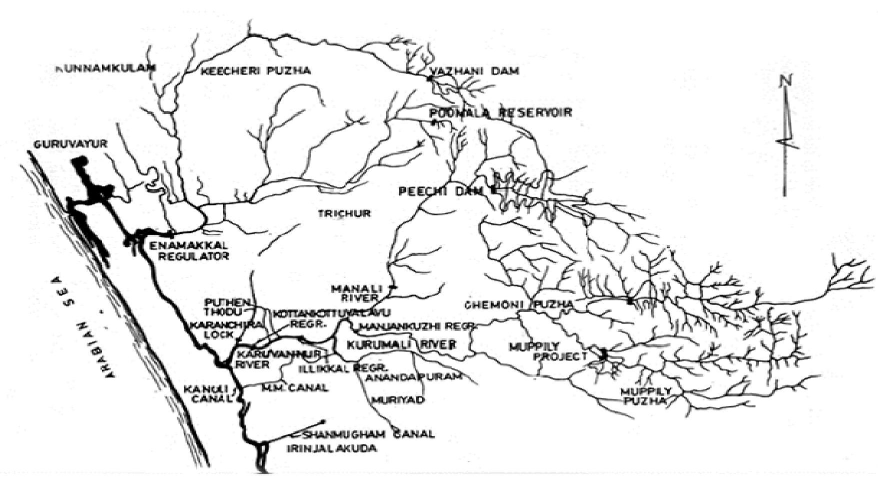

Fig.2.1 The Kole lands of Kerala

2.2 Topography

Kole land is a flat saucer shaped low-lying area, flanked by lateritic hills on the eastern and western margins. The Kole lands remain submerged under flood water for about six months in a year. The water level rises up to 5.50 m during the southwest monsoon. It is reported that about 233.74 million m^3 water is contained in the Kole lands. Kole lands lie parallel to the sea and a net work of main and cross canals provides external drainage and connects the different regions of the Kole to the rivers. Geologically, Kole is a low lying area with alluvium deposits brought down by the Kechery and Karuvannur Rivers. The flood water from the rivers used to bring enormous quantities of nutrient rich alluvium, which gets deposited in the Kole lands. The cyclical nutrient recharging of the wetland during the flood season rendered the area as one of the most fertile soils of Kerala. This is indicated by the fact that ‘while the average productivity of rice in the state is less than 2 tons per ha, Kole lands yield 4 to 5 tons of rice per ha.

2.3 Climate

Moderate climatic conditions are experienced in the Kole land area. The area has a recorded minimum temperature of 21 °C and a maximum of 38 °C. Air is humid (85.00 to 95.00 per cent during June-September and 70.00 per cent during January) as in other areas of the state, Kole lands also receive two well-defined rainy seasons, the South-West and North-East Monsoons. The mean annual rainfall recorded in the Kole lands is 2757.00 mm out of which 67.30 per cent is received during S-W monsoon and 18.00 per cent during N-E monsoon. The phenomenon of depression rains which is noted during October to November is also another source of water for the Kole lands. Mean Pan Evaporation in the Kole tract is 5.80 mm per day**.**

2.4 Geological features

It is believed that Kole lands along with the Vembanad estuarine areas have been formed by an upheaval of the shoreline subsequent to the regression and transgression of the coastal waters in the past. The Kole land area is a submerged plain land representing piedmont type of deposits, silted up with alluvium brought down by Karuvannur and Kechery Rivers. The eastern border of the Kole land is characterized by low-lying hills, which is essentially a crystalline terrain.

2.5 Petti and para

‘Petti and para’, the most common dewatering pump prevalent in Kole lands are mainly driven by 30 hp to 50 hp electric motor.Theindigeneous axial flow plump popularly known as petty and para. ‘petti and para’ was designed by a British engineer, George Brendon in 1918. The ‘Petti’ (wooden box) and ‘Para’ (wooden or metallic cylinder) were made from locally available workmanship. These pumps can operate from zero to three meters heads and sometimes in negative heads also. Other means of dewatering are low head centrifugal pumps and locally manufactured propeller pumps.Though the ‘petti and para’ has low initial cost but its operating energy efficiency is very low.

The 'Petti' and ‘Para’ consists of a rotating impeller housed inside a cylindrical wooden drum called 'Para'. By the rotation of impeller the hydro dynamically activated water flows axially upwards through the 'Para', takes a 900 turn and flows out through a horizontal rectangular wooden outlet called ‘Petti’. The impeller with shaft is suspended from a thrust bearing resting on a stand tube. ‘Petti’ is rigidly housed to the embankment made of bamboo and mud. The axial load on ‘Petti’ is thus transferred to the basement. Blades of the impeller are bolted to the shafts. The ‘Para’ was first made of wood and now by iron, and is made water-tight. A flat pulley is provided at top of main shaft. Discharge pipe, the ‘Petti’ is made up of boat quality wood in rectangular shape. Top of the ‘Para’ is fitted to the ‘Petti’. Thus the water lifted up by the rotation of the impeller rises up through the ‘Para’ and flows across the bund through the ‘Petti’. Most of the ‘Petti’ and ‘Para’ are operated by motors in the range between 25 hp and 100 hp. The motors usually used are slip ring type, fitted with the outdated oil immersed starters. Flat quarter turn belt drive of about 6 to 10 m length and 20 cm in width is used to take the power to the impeller shaft. The motor shaft is horizontal and that of impeller is vertical to the ground. ‘Para’ is vertically hung on a pair of rails mounted on a masonry structure.

Abraham (1988) conducted field survey and the general characteristic of the ‘petti and para’ were collected. Tests were done on 15 hp and 20 hp ‘petti and para’ using standard methods. For 15 hp pump the discharge varied from 217.75 lps to 143.63 lps against a head of 65.00 cm to 100.00 cm with an efficiency ranging from 21.19 percent to 18.16 percent. For a 20 hp ‘petti and para’ the discharge was 369.50 lps to 281.20 lps against a head of 73.00 cm to 132.00 cm with an efficiency of 21 percent to 26 percent for a propeller pump of speed of 1100 rpm the discharge was 39.64 lps to 13.34 lps against a head of 183.00 cm to 283.00 cm with an efficiency of 23.72 percent to 9.60 percent. The input power to the motor was 10 hp.

Saji (1994) conducted studies on the effect of various parameters on the performance of ‘petti and para’ in specially designed and constructed test bed at KAU, Vellanikkara. Tests were conducted by varying the number of blades on the impeller. For a 4 bladed impeller, the maximum efficiency obtained was 23.72 percent at 350 rpm against a head of 89 cm with a discharge of 291.83 lps. Input power supply was 14.62 hp. For a 5 bladed impeller, maximum efficiency was 30.09 percent at 330 rpm with an input power of 13 hp. For a 6 bladed impeller, the maximum efficiency obtained was 18.98 percent at 305 rpm. He concluded that 5 blade impeller is most suitable for a 15 hp ‘petti and para’ with a working speed of 330 rpm.

2.6 Axial flowpropeller pumps

Propeller pumps are axial flow pumps in which the fluid enters and exits along the direction parallel to the rotating shaft. The fluid is not accelerated where as "lifted" by the action of the impeller in which the pressure head is developed mostly by the propelling or lifting action of the propeller blades as it rotates.A propeller pump is specially adopted to get high discharge at low heads .It is most suitable to lift water from canals,rivers and streams for dewateringdewatering at heads.it has high efficiency under low heads especially within 4m.It can be used as portable units operated by light weight engines or in permanent installation using electric motor or engines. The basic elements of a propeller pump are the propeller and diffuser, often forming a distinct bowl assembly which is submerged under the liquid to be pumped. A flared entrance below the propeller is used to reduce entrance losses. The impeller operates in a cylindrical casing which is an extension of the discharge column assembly. The impeller usually has 3-6 blades depending on the design specific speed. The blades are set on the shaft at angles determined by the total head and operating speed of the pump. The propeller is mounted on a suitable shaft. The propeller blades are carefully filed and scraped to reduce skin friction. They are keyed to the drive shaft and are accurately positioned by a locking collar and nut. A cone-shaped cover is usually installed over the locking nut to eliminate eddies and prevent the entry of sand or grit into the lower pump bearings. The diffusion vanes smooth out the disturbances caused by the propeller. The propeller is mounted on a suitable shaft.

The column assembly of a propeller pump comprises the line shaft which joins the impellor with the driving head shaft. The line shaft is provided with suitable bearings, usually grease lubricated. Discharge column is a combination of a column pipe and delivery bend, and is designed so as to reduce hydraulic losses to the minimum. It is specially machined for accurate alignment. A cover plate is bolted on top of the discharge head, which provides a seat to the skirt of the driving head which comprises a vertical motor and arrangement for oil/water lubrication. An impeller adjusting nut is provided at the top of the motor. The thrust is borne by a thrust bearing located in the top cover of the motor.

Anilkumar (1987) designed and fabricated an axial flow pump for a discharge of 250 lps and head of 2.00 m. Cast iron and MS replaced the wooden parts of the conventional ‘petti and para’. The ‘Petti’ was made of cast iron sheets and ‘Para’ of cast iron sheet metal. Pump was tested at 960 rpm and 730 rpm. Discharge varied from 161 lps to 210 lps against total heads of 98.00 cm to 160.00 cm and the efficiency obtained varied from 28.64 percent to 24.78 percent at 730 rpm. Maximum efficiency obtained was 28.72 percent with a discharge of 176.50 lps against a head of 152.00 cm. At 960 rpm the efficiency was 23.89 percent with a discharge of 230.50 lps and the total head was 152.00 cm.

International Rice Research Institute, Los Banos, Philippines (1979) designed and developed a portable and low cost axial flow pump having a capacity of 25 to 50 lps at a head ranging from 1.00 m to 4.00 m, which could be coupled to a 5 hp motor. A maximum efficiency of 69.10 percent with a discharge of 45 lps against a head of 2.50 m at 2890 rpm was observed.

Calilung et al. (1982) measured capacities of an axial flow pump 15.00 cm diameter and a centrifugal pump 10.00 cm diameter for low lift conditions. Test results showed that for heads between 3.00 m and 1.00 m, the capacity of axial flow pump was 2 to 3 times greater than that of centrifugal pump. Both the pumps had about same discharge at 4.00 m lift.

Sasi (1984) designed and developed a propeller pump with a three bladed impeller at specific speed of 250 rpm. The pump was tested at two water levels above impeller, one 20.00 cm above the impeller and other 10 cm above the impeller. For the above two cases at the designed head of 1.50 m the efficiencies obtained were 33.00 percent and 29.00 percent corresponding to discharge rates 121 lps and 114 lps. The maximum efficiencies obtained at these water levels were 33.07 percent and 29.61 percent against total heads of 1.41 m and 1.54 m respectively at the discharge rates of 124.88 lps and 114.10 lps. The maximum working capacity was 165.19 lps against a head of 1.00 m with an efficiency of 31.95 percent.

Taneja and Kausal (1986) designed and fabricated two types of propeller pumps – inclined propeller pump and vertical pump. The inclined pump was able to lift water at the rate of 44.00 to 35.00 lps against a total head ranging from 1.20 to 2.90 m and correspondingly the efficiency varied from 50.00 percent to 80.00 percent at 2600 rpm. When operated at 3000 rpm it delivered water at the rate of 56.30 to 43 lps. For heads of 1.67 to 3.68 m and the efficiency varied from 65.00 percent to 31.00 percent. The pumping tests on vertical propeller pumps showed that at 2800 rpm, the discharge varied from 32.00 to 19.00 lps at static heads ranging from 84.00 cm to 250.00 cm. The efficiency of the pump was found to vary from 65.00 percent to 31.00 percent.

Anon, (1987) developed a small and compact pump designed specifically for low lift applications. The ‘Silpa’ pump as it is nick named, is a low cost propeller pump or axial flow pump ideal for raising water 1 to 2 m high. It is easily installable, portable and can be fabricated from locally available materials. A 15.00 cm diameter pump powered by a 7 hp engine has an output of about 40.00 lps for a lift of 1.50 m. This capacity is 2-3 times higher than that of either a centrifugal pump or an axial flow pump using a boat propeller having same lift and engine power. The difference is due to the specially designed propeller which provides high efficiency for low lift pumping.

Chaiyaphol (1996) studied the performance of 15.00 cm Thai made axial flow pump and mixed flow pump. Both the pumps were tested under a total static head of 1.00 m for different speeds. When axial flow pump was tested over a speed range of 1800 rpm to 2600 rpm, the discharge rate varied from 14.40 to 30.50 lps. The mixed flow pump was tested over a speed range of 575 to 1000 rpm. The efficiency varied from 25.90 percent to 56 percent and discharge varied from 11.75 to 51.09 lps. The maximum efficiency of 56.00 percent was obtained at 1000 rpm and the discharge rate was 51.09 lps.

Barbier et al. (1997) The Ramsar International Convention defined wetlands as 'areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt including areas of marine water, the depth of which at low tide does not exceed 6 m'.

Rini Rani (1998) conducted experiments on the performance characteristics of 15 cm axial and mixed flow pumps at specially designed and constructed test bench. The pumps were tested at different speeds and for mixed flow pump maximum efficiency of 42.16 percent was obtained at a speed of 1000 rpm against a total head of 217.33 cm and for a discharge rate of 49.47 lps. The then input power was 3.4 hp. For axial flow pumps, the maximum efficiency obtained was 18.05 percent at a speed of 2500 rpm at a total head of 160.55 cm and a discharge of 24.88 lps. The corresponding input power was 2.95 hp.

Sharma and Singh(2003)designed, fabricated and tested under field condition to operate the propeller pump with good discharge and efficiency. The pump was operated with a 5hp diesel engine at 1000 rpm under field situation and was tested at different heads at the fixed speed. The variation of discharge was in a narrow range at lower heads. The optimum operating head of the pump was found to be 1.2 m at which the discharge rate was 33lps and efficiency of the pump was 14.8 percent.

TNAU designed a propeller pump with the flexible transmission system operated by Power tiller. The rigid transmission system was developed by Thakur (1998) and tested under laboratory conditions and by Rai and Dilmani (1999) under field condition in College of Agricultural Engineering, Pusa, Bihar, India. But due to high power input, the efficiency of the pump was very low (4 percent).

The above reviews revealed that, the axial flow propeller pumps operating at heads below 4m have better efficiency than petti and para and centrifugal pumps. Vertical axial pumps resulted better performance in wider range of low heads. All the above pumps reviewed onlyin researches carried out with smaller versions. It is understood from the literatures that not a single factory manufactured low head- high discharge propeller pump has been installed in Kole lands or Kuttanadof Kerala so far. A 50 hp axialflow propeller pump was installed and tested at Chemmandakayal kole padavu,Karalam,Thrissur under a government project 'DIFM Package for

Kerala',during 2012-2013. Its performance was studied and compared with the results obtained by various researchers on petti and para and axial flow propeller pumps.

Materials and methods

Chapter III
MATERIALS AND METHODS

This chapter describes the various components of petti and para,axial flow propeller pump, selection and testing with three types of impellers and diffuser for improving efficiency of the pump. As a preliminary investigation, the field problems due to water logging in Kole land and dewatering techniques using petti and para were studied and analyzed. A laboratory model of the axial flow pump was developed and tested for its discharge are also briefly described.

3.1 Kole lands: Location and features

The Kole wetlands cover an area of about 13,632 hectares spread over Thrissur and Malappuram districts of the state. The area extents from Chalakudy river in south toBharathapuzha river in the north and to some parts of Ponnani taluk. These Kole wetlands act as natural drainage system through a network of canals and ponds in Thrissur district, which connects different parts of Kole wetlands to river and Arabian sea. It is fertile with alluvium soil which is deposited by Kechery and Karuvannoor rivers in the monsoon. Agriculture is the major occupation of the people of Kole wet land and ninety percent of people are practicing mostly paddy cultivation. Weeds are major constraint for higher productivity in rice in these areas.

Introduction of the locally made propeller pump, known as Petti and Para had revolutionized the drainage pumping of the region in the early twentieth century. Petti and Para is a traditional dewatering pumping system manufactured by local blacksmiths and carpenters. It is a special pump driven by electric motors of 25 to 100 hp and discharges water with high flow rate against low heads. Petti and Para is originally designed by Mr. George Brendon, a British engineer in 1918 by using locally available materials. The pump is connected to the motor using a long belt. Petti and Para has high discharge capacity under low head conditions. But its efficiency is less than 25 per cent. Several types of pumps are available for lift irrigation and drainage under different head and discharge conditions, such as centrifugal pump, turbine pump, submersible pump, mixed flow pump and propeller pump. But centrifugal pump is efficient for above 4 m delivery head and having low-head discharge.

It is estimated that there exists 800 petti - para pumping units in Thrissur and Ponnani Kole lands of the State. If considered the requirement at Kuttanad of Alappuzha district, the advantages and net saving of electric energy and expenditure will be exorbitantly high. In this context, it is the high time to replace low efficient and high energy requiredpetti and para pumps with suitable pumping systems with more efficient and less power consumption pumps *viz.*, axial flow pumps at the rice bowls of Kuttanad and Kole lands of the state.

3.2 'Petti and para'

Dewatering of Kole lands is carried out mainly by using petti and para.The 'petti' and 'para' consists of a rotating impeller housed inside a cylindrical wooden drum called 'para'. By the rotation of impeller the hydro dynamically activated water flows axially upwards through the 'para', takes a 90^0 turn and flows out through a horizontal rectangular wooden outlet called 'petti' . The impeller with shaft is suspended from a thrust bearing resting on a stand tube. 'Petti' is rigidly housed to the embankment made of bamboo and mud. The axial load on 'petti' is thus transferred to the basement. Vanes of the impeller are bolted to the shafts of the impeller. The 'para' is originally made of wood and now by iron, and is made water-tight. A flat pulley is provided at top of iron shaft. Discharge pipe, the 'petti' is made up of boat quality wood in rectangular shape. Top of the 'para' is fitted to the 'petti'. The water is lifted up by the rotation of the impeller causing rising of water through the 'para' and flows across the bund through the 'petti'. Most of the 'petti' and 'para' are operated by motors in the range of 25 to 100 hp. The motors usually used are slip ring type, fitted with the outdated oil immersed starters. Flat quarter turn belt drive of about 20 cm in width is used to transmit the drive to the impeller shaft. The motor shaft is horizontal and that of impeller is vertical. Length of the belt is about 10 m. 'Para' is vertically hung on a pair of rails mounted on a masonry structure. Specifications of the 'petti' and 'para' vary like Kuttanad type and Thrissur- Ponnani type. Kuttanad model is made of 'Anjili 'and 'Tharubagam' timber while Thrissur model by 'AnjilyMilal' and 'pongu'. Bottom of the 'para' is provided with a butterfly mild steel foot valve for restricting the backward flow.

3.3 Vertical axial flow propeller pump

The vertical axial flow propeller pump (Fig.3.1) installed at Kadampattupadam kole padavu, Chemmanda kayal, Karalam, Thrissur is having its axis in vertical direction in which water enters and ejects along the direction parallel to the axis of rotation. These pumps consist of a prime mover of 50 hp electric motor, thrust bearing, main shaft, stuffing box, impeller, elbow, delivery pipe, bell mouth, and a screen. The pressure head is developed by the propelling or lifting action of the impellers as it rotates. The rotation of the impeller is caused by the prime mover in on position. The water enters to the impeller through screen provided beneath the bell mouth which removes the impurities and other debris from entry to suction side of the impeller. The bell mouth is a bell(curvilinear) shaped column assembly which allows water to enter smoothly in to the impeller. The impeller operates at the bottom of the delivery pipe. The impeller has 3-6 blades depending on the designed speed and is keyed at right angles at the bottom of the main shaft. A cone shaped cover is fitted over the locking nut to eliminate eddies and to prevent the entry of sand and grit into the lower pump bearings.

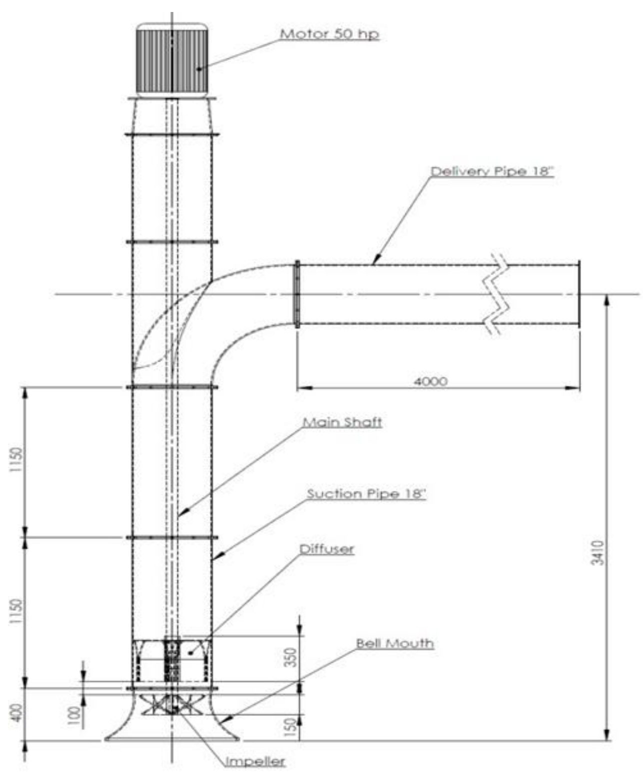

Fig.3.1 Vertical axial flow propeller pump

3.3.1 Prime mover

A 3- phase induction motor of 50 hp, 6-pole and 960 rpm slip ring induction motor is used as prime mover. An oil immersed slip ring motor starter is used as a starting aid for such motors. An electric panel with fuse, energy and volt meters with proper insulation and earthing is used for the said pump.The fuse protects the motor from excess voltage and the energy meter is used for measuring power consumption while operating the pump.

3.3.2 Thrust bearing

These bearings actually hold and connect the motor with the main shaft assembly. It takes all the undue forces acting radially to the main shaft while in rotation. Also, safe guard the pump and motor units from vibrations and resistive forces. It has an outer diameter of 150mm and inner diameter of 85mm. It is made of stainless steel material.

3.3.3 Main shaft

This shaft holds the impellers at the bottom end and is connected with the motor at the top through thrust bearing. The shaft has a diameter of 63.5mm and length of 4.2m made of stainless steel material. It is also provided with 3 key ways respectively for connecting impeller at the bottom, couplings at the middle and thrust bearing at the top. The main shaft passes through the elbow and delivery pipes, suitably welded with leak proof column assembly over the elbow.

3.3.4 Stuffing box

It is used for preventing leakage of water.It is provided for making the assembly intact and leak proof. It is made of gun metal provided with shaft sleeve with proper gland packing and follower.

3.3.5 Impeller

Impeller is the major part of the pump for lifting water. It is a rotor used to increase the pressure and flow of water. The velocity achieved by the impeller from the motor transfers it into pressure energy during the upward movement of water. Three types of impellers (Fig.3.2) were used for the study. It consists of four vanes (blades) fitted on a hub made of mild steel.

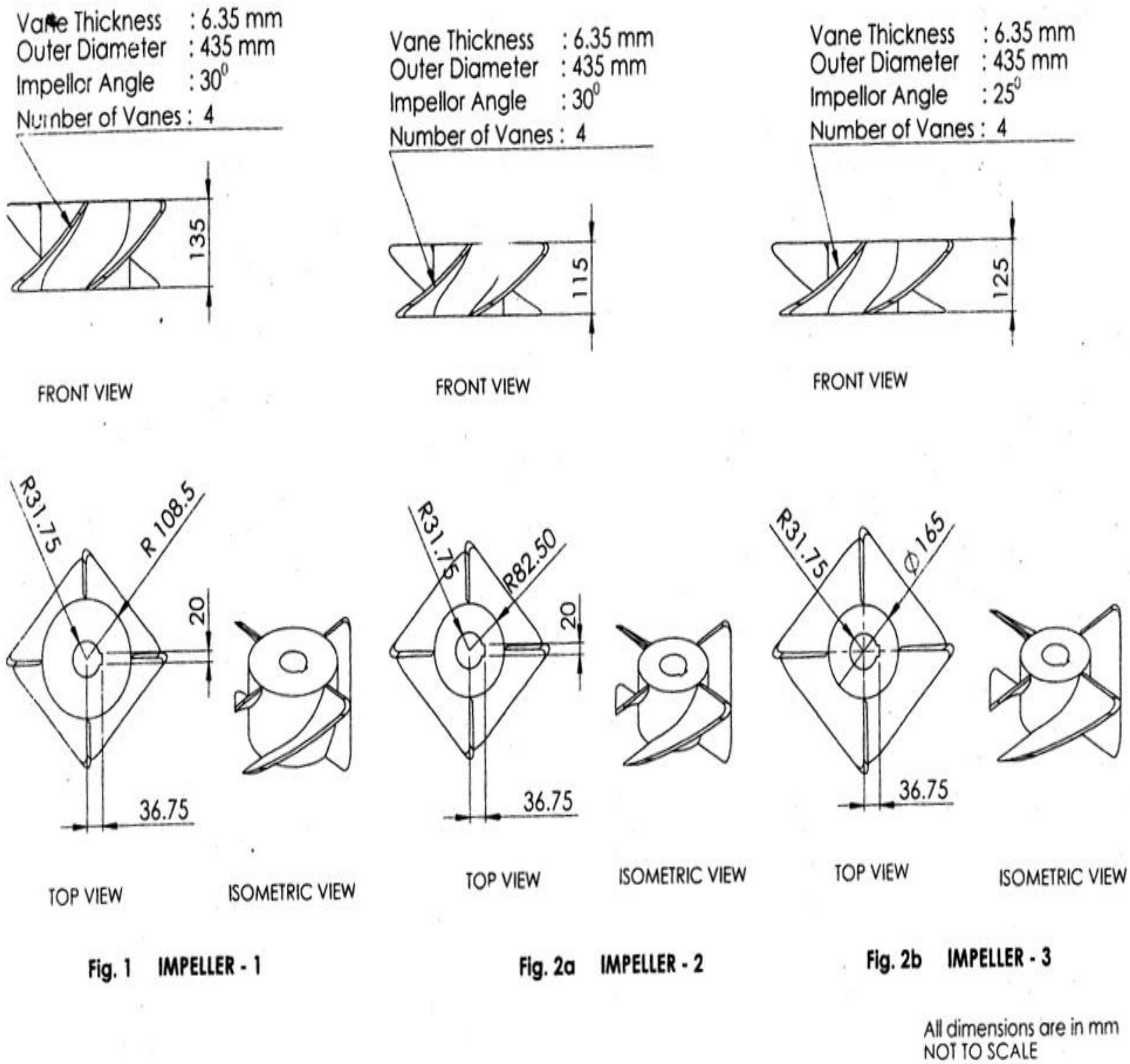

Fig.3.2 Three types of tested impellers

3.3.6 Elbow

It is made of mild steel seamless pipe of diameter of 675 mm connecting the other horizontal and vertical discharge pipes respectively for pumping water to the canal and to receive water from the delivery side of impellers. The elbow is provided with 90 deg. with finished inner curvature for smooth delivery of water through the pipe. A vertical column assembly having main shaft is suitably welded over the elbow to provide leak proof water pumping system.

3.3.7 Delivery pipe

These pipes are fitted just above the impeller and its one end is connected to the outlet of the pump. It is made in three column delivery pipes of diameters 475 mm each having 1.15 and 0.6 m respectively joined by means of spool pieces.

3.3.8 Bell mouth with screen

It is a bell shaped pipe of 675 mm having a wider diameter at the bottom,so has to have a smooth entry of water to the suction side of the impeller. It is also made of mild steel seamless pipe of 25 cm height. A screen is provided at the beneath of the bell mouth to prevent the entry of impurities into the impeller.

3.4 Principle

The axial flow propeller pump ensures high discharge, low head pumping. A propeller pump develops pressure head by the propelling action of impeller blades on water. These pumps propel water by the reaction to lift forces produced by rotating its blades. For the sustainable agriculture operation, the use of axial flow propeller pumps as against the traditional system should be promoted as it accounts for the energy and cost saving technology.

3.5 Testing

The efficiency of the pump depends on its discharge rate against the operating head and the input electrical power. The performance curves of the pump were drawn as head and efficiency on ordinate and discharge on abscissa. The discharge was measured using a rectangular weir and the energy input was observed using the energy meter fitted in the electrical control panel of the pump.

The flow of water at the inlet side was controlled using wooden sluice regulator installed at the Centre of the temporary earthern bund constructed using wooden bamboo, coir, sand and gravel packing. The suction and delivery head was noted by using tape . The discharge rate was calculated by using the equation given 3.5.3.1. The voltage and current of the electric supply was noted using the volt meter and ammeter fitted in the electric panel. The input energy was then calculated and the efficiency was determined as mentioned in the art.3.4.3.

3.5.1 Temporary earthen bund and wooden sluice regulator

It was constructed to control the inflow of water at the suction side of the pump. A wood sluice regulator was installed at the center of the earthen bund to regulate the flow of water. The schematic representation of the bund and regulator are illustrated in the Fig.3.3 and Fig.3.4. The materials used for the construction is given in the appendix

A wooden sluice regulator (Fig. 3.1) is provided near the bund to regulate the water flow. It consists of three wooden planks made of good quality mango wood with mild steel fixtures for clamping. It can be moved up and down according to the flow of water.

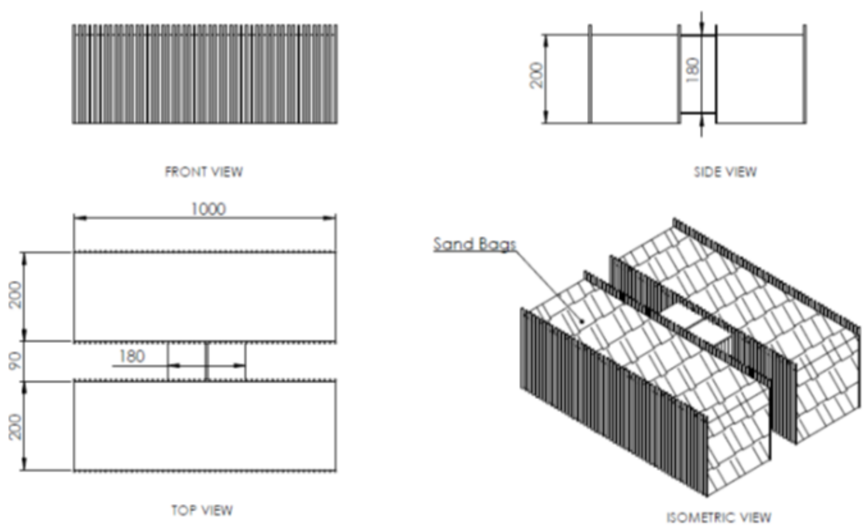

Fig.3.3 Earthen bund and wooden sluice regulator

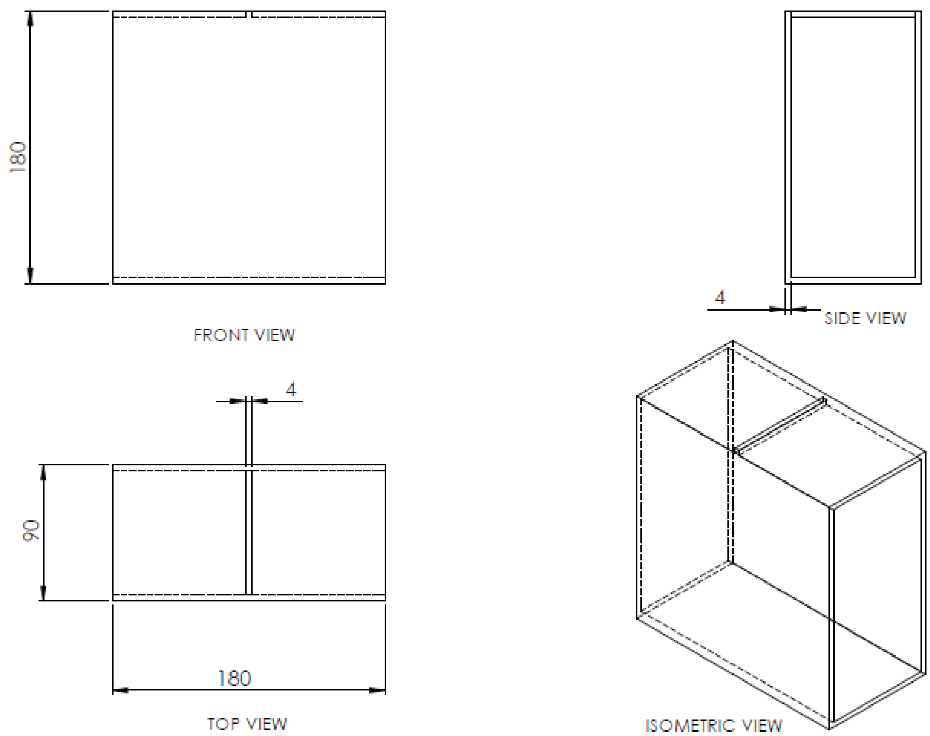

Fig.3.4 Wooden sluice regulator

3.5.2 Rectangular wire mesh

A rectangular wire mesh (Fig. 3.5) was fabricated using mild steel and placed below the impeller to prevent the large sized debris like plastic bottles, wooden pieces etc. which may cause clogging at the inlet side.

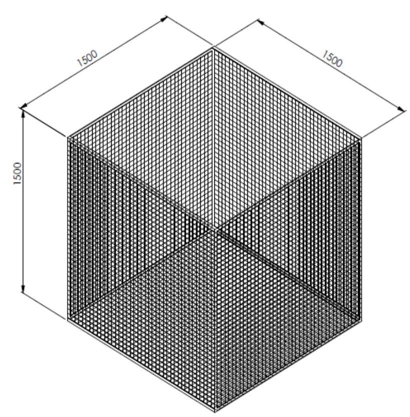

Fig. 3.5 Rectangular wire mesh

3.5.3 Discharge rate

Discharge rate was measured using a rectangular weir fixed at the delivery canal. The weir is fixed at 1.5m away from the end of discharge pipe. On starting the motor the water discharged is allowed to flow through the weir. The head of water on the weir is noted and the discharge is calculated using the equation as explained in art 3.5.3.1

3.5.3.1 A rectangular weir

A rectangular weir (Fig.3.6) of size 1250x850 mm was installed at the delivery canal, i.e. 1.5m away from the end of delivery pipe to avoid eddies effect. The water level above the weir (H) was measured using a tape. The discharge rate of the pump was calculated using the formula,

$Q= 0.0184LH^{3/2}\ m^3s^{-1}$

Q=discharge,m^3s^{-1}

H= head on the weir, m

L= length of weir, m

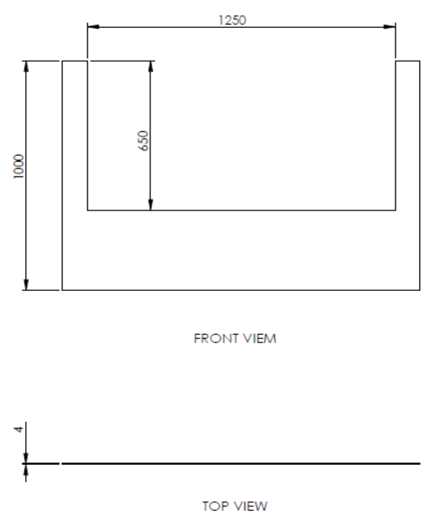

Fig.3.6 The rectangular weir

3.5.4 Input energy

An energy meter was fitted in the electric panel to observe the variation of energy consumption at varying suction head and available voltage. The reading corresponding to head and voltage was observed and power consumption was calculated using the equation,

$P= \sqrt{3}\ VI \cos Ø$

P= Input power, kW

V= voltage, volt

I=current, ampere

Cos Ø = power factor

3.5.5 Efficiency of the pump

The input power from the electric motor is transmitted to the shaft of the pump and then to the impeller. From the impeller the power is given to the water. Efficiency of the pump is the ratio of water to the input electric power

Efficiency, $\dot{\eta} = \frac{WHP}{Input\ power}$ x100

3.5.6 Testing the pump with impellers and diffuser

Three types of impellers with 4 numbers of vanes having outer diameter of 435mm, vane thickness of 6.35mm were selected based on the proper fitting and minimum clearance between the impeller and inner diameter of suction pipe. The different vane angles selected were 30 and 25 degree and height of impellers as 135,115 and 125mm respectively of impeller 1, 2 and 3.A diffuser with 6 numbers of vanes with an outer diameter of 440 mm was selected, so as to increase the efficiency of the pump.

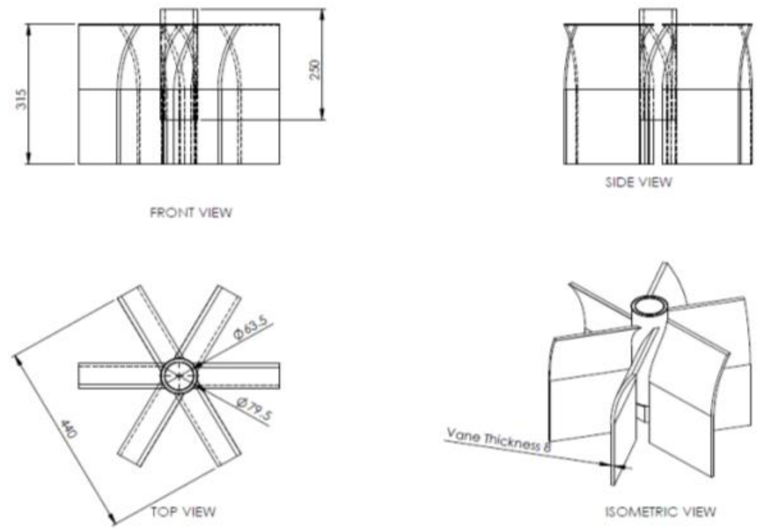

Fig.3.7 Diffuser

3.5.7 Performance characteristics

The performance characteristic curves are necessary to predict the behavior and performance of the pump when the pump is working at different conditions. It was plotted as head and efficiency on ordinate and discharge on abscissa.

3.6 Development of a Laboratory model of the axial flow propeller pump

A laboratory working model of axial flow propeller pump was fabricated of the size 2:1 and tested. A 3 φ induction motor of 3 hp is used as the power source mounted vertically over the whole unit. An oil immersed slip ring motor starter is also provided as a starting aid for the 3 hp motor. An energy meter is used for measuring power consumption while operating the pump. Two impellers were designed for this model. First one in open type with four numbers of vanes and second one in French wheel type with six number of vanes. These impellers are made of mild steel. Impeller-diffuser assembly is caged inside the bell mouth. It is made of mild steel with a height of 220mm. The bottom diameter of bell mouth is 225mm and that of the top is 150mm.It provides a smooth entry of water to the suction side of the impeller. It is then connected to a discharge pipe which is used to deliver water to the outlet. It is made of mild steel with a length of 750mm.

Plate.3.1 Laboratory model of the axial flow propeller pump

Results and discussion

Chapter IV

Results and Discussion

In this chapter, the technical specifications of the axial flow propeller pump, impellers and diffuser selected for the study are briefly explained. Also, the performance of the axial flow pump with three types of impeller-diffuser assembly is presented at various head and voltage conditions prevailing at the installed site. Its results are compared with petti and para operating with 50 hp electric motor is also presented.The details of the lab model developed under the study and evaluation are also explained.

4.1 The axial flow propeller pump

The axial flow propeller pump installed at Chammanda kayal kole padavu, Karalam, Thrissur was studied in detail. The technical specification of pump is as given in Table 4.1

Table 4.1 Specifications of the axial flow propeller pump

Sl.No.	Items(1 each)	Specifications	Materials
1.	Electric motor	50hp,960 rpm	
2.	Delivery pipe	Height 5000 Ø457	MS-Seamless
3.	Elbow	Height 675 Ø457	MS-Seamless
4.	Thrust bearing	Outer Ø150 Innerø85	MS-Seamless
5.	Main shaft	Length 4200,Ø125 Key ways-3	SS-304

6.	Spool piece -1 -2 -3	Height 600 Height 1150 Height 1150	MS-Seamless
7.	Impeller a)Hub b)Vanes	Length 150,Ø125 Key ways-20 Ø392,No:4 Thickness-8 Angle 30^0	MS-Seamless
8.	Bell mouth	Height 675, Ø457	MS-Seamless

- All dimensions are in mm

4.2 Discharge and efficiency

The discharge of the pump without diffuser at various head and voltage condition was determined using a rectangular weir installed at the upstream side of the pump. The input energy was taken using an energy meter fitted with the electric panel of the unit. The efficiency was calculated using the equations explained in art 3.5.

4.3 The impellers

Three types of impellers were fabricated with varying dimensions so as to match with the suction pipe fitted with the pump.The specifications of these impellers are as given in the Table 4.2.

Table 4.2 Specifications of the impellers

Sl. No	Details	Impellor I	Impellor II	Impellor III
(a) Impellor Hub:				
i	Outside diameter	217 mm	165 mm	167 mm
ii	Inside diameter (Bore)	63.5 mm	63.5 mm	63.5 mm
iii	Length	135 mm	115 mm	125 mm
iv	Key way width	20 mm	20 mm	20 mm
v	Material of construction	Mild steel	Mild steel	Mild steel

(b) Impellor

i	No. of vanes	4	4	4
ii	Thickness	6.35 mm	6.35 mm	6.35 mm
iii	Impellor angle	30^0	30^0	25^0
iv	Impellor vane height	135 mm	115 mm	125 mm
v.	Impellor diameter -outer	435 mm	435 mm	435 mm
vii	Material of construction	Mild steel	Mild steel	Mild steel

Plate 4.1 Three types of impellers

4.4 The diffuser

It is used for the complete conversion of kinetic energy into pressure energy to get desired height for increasing efficiency. The specification of the diffuser is as given in the Table 4.3.

Table 4.3 Specification of diffuser

Sl. No	Parameters	Dimensions (mm)
1.	Vane thickness	8.00
2.	Outer diameter	440.00
3.	No. of vanes	6.00
4.	Height of vanes	315.00
5.	Outer diameter of the hub	79.50
6.	Inner diameter of the hub	63.50

4.5 Discharge and efficiency improvements

The discharge and efficiency of the pump was determined using the equations as explained in art.3.5.3 and 3.5.5. It was calculated at varying head and input voltage for each of the three impellers and diffuser assembly. The results are given in the Table 4.4

Table 4.4 Discharge and efficiency using three types of impellers

Head (m)	Impeller 1				Impeller 2				Impeller 3			
	Discharge (lps)	Input power (kW)	WHP	Efficiency (%)	Discharge (lps)	Input power (kW)	WHP	Efficiency (%)	Discharge (lps)	Input power (kW)	WHP	Efficiency (%)
0.57	521.31	25.76	2.91	11.30	478.43	14.57	2.70	21.02	448.72	14.50	2.60	18.00
1.32	590.20	32.24	**7.01**	22.00	480.93	14.79	**6.22**	42.06	450.96	14.79	**6.00**	40.09
1.58	**528.68**	29.**15**	8.13	28.06	**488.82**	21.33	7.56	35.48	493.64	**17.51**	7.65	43.60
2.13	**528.44**	32.24	16.55	32.10	490.99	25.76	10.24	39.78	540.33	**21.33**	11.27	52.43
2.51	470.80	37.10	11.58	31.07	530.21	32.68	13.04	39.90	560.82	25.76	13.79	53.55
3.13	**380.99**	**34.45**	**11.62**	32.00	**555.40**	**43.54**	**17.93**	**41.18**	**571.81**	**34.16**	**19.31**	**56.09**

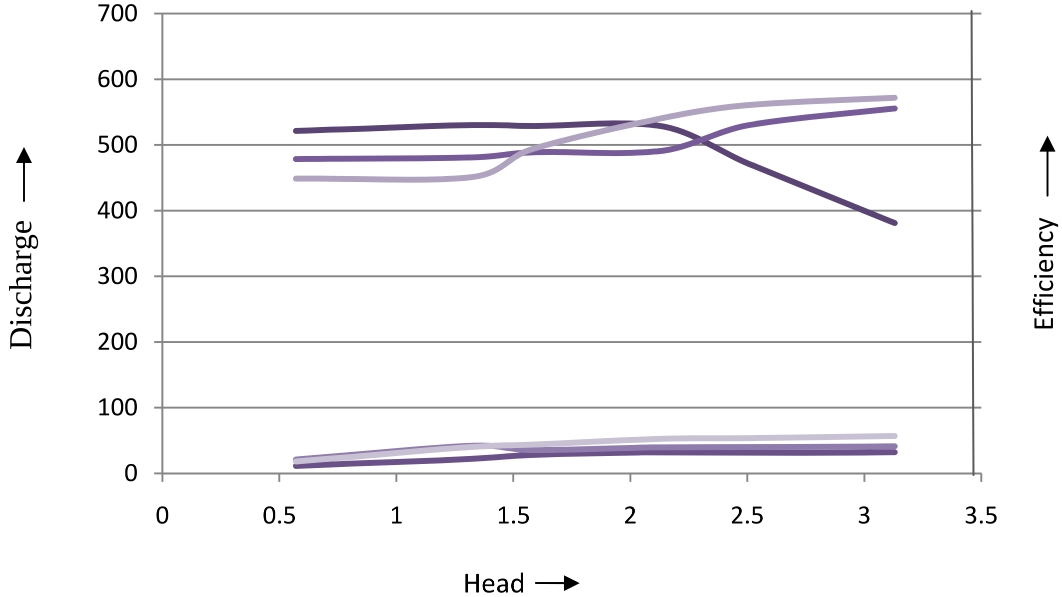

Fig 4.1 Performance curve of the pump with three impellers

4.6 Comparison with petti and para

Saji, M. K. (1994) conducted studies on the effect of various parameters on the performance of 'petti and para' in specially designed and constructed test bed at KAU, Vellanikkara. Tests were conducted by varying the number of blades on the impeller. For a 4 bladed impeller, the maximum efficiency obtained was 23.72 percent at 350 rpm against a head of 89 cm with a discharge of 291.83 lps. Input power supply was 14.62 hp. For a 5 bladed impeller, maximum efficiency was 30.09 percent at 330 rpm with an input power of 13 hp. For a 6 bladed impeller, the maximum efficiency obtained was 18.98 percent at 305 rpm. He concluded that 5 blade impeller is most suitable for a 15 hp 'petti and para' with a working speed of 330 rpm.

The discharge and efficiency of axial flow propeller pump with diffuser are presented in Table 4.4. The results indicated that the discharge and efficiency of the pump were increased at the same head and voltage condition. Also obvious from the results obtained with the pump attached with the new impeller indicated that the efficiency and discharge has improved from 32 to 56 per cent. It is very well indicated that due to the fixing of a diffuser at the immediate delivery of the impeller, the efficiency and discharge increased and obtained a smooth outflow of water through the discharge pipe. Also the eddies formed in the discharge water is totally disappeared due to the fixing of the diffuser.

4.7 Laboratory model of the axial flow pump

A laboratory model of the propeller pump was developed and tested at varying head.

Summary and conclusion

Chapter V

Summary and Conclusion

The Kuttanad and Kole lands of Kerala are the low lying lands subjected to flooding during rainy season mainly due to inadequate drainage facilities. By early twentieth century, the 'Petti and Para pumping system' was introduced for the dewatering operations in these lands, which revolutionized the drainage pumping system of the area. Different models of 'Petti and Para pumping systems' are available which are inefficient due to its poor operation and maintenance. Hence, highly efficient pumps for the dewatering are necessary and need of the hour, especially due to the severe scarcity and high cost of electric power. Of the several types of pumps available for dewatering, the axial flow propeller pump ensures high discharge, low head pumping. A propeller pump develops pressure head by the propelling action of impeller blades on water. For the sustainable agriculture operations, the use of axial flow propeller pumps as against the traditional system should be promoted as it accounts for energy and cost saving technology.

In this study, the axial flow propeller pump installed at Chammanda kayal kole padavu, Karalam, Thrissur were studied in detail and its efficiency and discharge were found out at varying head and voltage condition. The experiment was conducted by regulating the inflow of water by temporarily constructing an earthern bund with a wooden sluice regulator fixed at the centre at the inflow side. A rectangular weir was installed at the canal about 1.5 m from the discharge end of the delivery pipe for measuring the discharge of the pump. The input energy was calculated using the energy meter fitted in the electrical panel. Study was also carried out to find the improvement in efficiency and discharge due to changing impellers and diffuser assemblies. The most suitable impeller-diffuser combination (Impeller-3) was selected as its efficiency was 56.69 % with a discharge rate of 571.81 lps at a head of 3.13 m.

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Appendix I

Efficiency calculations of the axial flow propeller pump with three types of impellers

1.Impeller 1

Initial level of water before pumping= 59 cm

Level of water during pumping = 94 cm

There for, Head on weir= 94-59= 35 cm

Distance from the static water level to the centre of the delivery pipe,H_1= 2.68

Length of the rectangular weir = 100 cm

Discharge = $0.0184LH^{3/2}$ $=0.0184x100x35^{3/2}$ = 380.99 lps

Area of the pipe=$3.14x0.4572^2/4$ =0.164 m^2

Velocity=Q/A = 380.99/0.164 =2.315 m/s

Therefore,static head,H_2 $V^2/2g$ = $2.315^2/(2x\ 9.81)$ =0.273 m

Total head=H_1+H_2=2.68+0.273 =2.95 m

Water horse power, WHP=QH/75 = 380.99x2.95/7 = 15 hp=15x.735=11.027 kW

Input power=1.73xVI cosø x efficiency=1.73x400x65x0.85x0.9 = 34.45 kW

Pump efficiency= output powerx100/input power = 11.027x100/34.45=32%

2.Impeller 2

Initial level of water before pumping= 61 cm

Level of water during pumping = 106 cm

There for, Head on weir= 106-61= 45cm

Distance from the static water level to the centre of the delivery pipe,H_1= 2.6 m

Length of the rectangular weir = 100 cm

Discharge= $0.0184LH^{3/2}$ = $0.0184x100x45^{3/2}$ = 555.4 lps

Area of the pipe=$(3.14x0.4572^2)/2$ =0.164 m^2

Velocity=Q/A = 555.4/0.164 =3.38 m/s

Therefore, static head,$H_2=V^2/2g = 3.38^2/(2x9.81)$=0 .649 Mm

Total head=H_1+H_2=2.6+0.649 = 3.25 m

Water horse power, WHP=QH/75 = 555.4x3.25/75 =24.07 hp=24.07x.735=17.93 kW

Input power=1.73xVI cosø =1.73x340x87x0.85 = 43.54 kW

Pump efficiency= output powerx100/input power=17.93x100/43.54=41.18%

3. Impeller 3

Initial level of water before pumping= 60.12cm

Level of water during pumping = 106cm

There for, Head on weir= 45.88 cm

Distance from the static water level to the centre of the delivery pipe,H_1=2.68 m

Length of the rectangular weir = 100 cm

Discharge= $0.0184LH^{3/2}$=$0.0184x100x\ 45.88^{3/2}$ = 571.81lps

Area of the pipe=$3.14x0.4572^2/4$ =0.164 m^2

Velocity=Q/A = 571.81/0.164 =3.67 m/s

Therefore,static head,$H_2=V^2/2g=3.62^2/2x9.81$ = 0.686 m

Total head=H_1+H_2=3.50 m

Water horse power,WHP=QH/75 =571.81x3.5/75= 26.68hp=26.68x.735=19.61 kW

Input power=1.73xVI cosø x efficiency =1.7x380x60x0.85x0.9 = 34.06kW

Pump efficiency= output powerx100/input power =56.69%

Appendix II

Trial run with one set of impeller- diffuser assembly

Starting time(am)	Ending time(pm)	Voltage (V)	Current (A)	Suction height (m)	Motor temp. (^{0}C)	Pump thrust bearing temp. (^{0}C)
8	7	395	60	1.70	60	50
8	7	380	61	1.80	60	52
8	7	378	62	1.80	62	52
8	7	378	62	1.80	62	53
8	7	382	61	1.90	62	55
7	7	380	60	1.80	60	55
7	7	380	60	1.80	60	53
7	7	355	65	1.85	62	53
7	7	380	60	1.75	60	52

Appendix III

Materials used for the construction of earthen bund and wooden sluice regulator

Sl.no	Items	Quantity/ Dimensions
i.	Land clearing	100 m^2
ii.	Earth work excavation	20 m^3
iii.	Random rubble dry masonry	20 m^3
iv.	P.C.C. for the foundation of sluice valve	0.5 m^3
v.	Empty cement bags	800 Nos.
vi.	Filling sand	10 m^3
vii.	Bamboo poles of 2.5 m long	700 Nos.
viii.	Coir	40 bundles
ix.	Wooden sluice regulator (1.8x1.8x0.9m) made of good quality mango wood timber plates of 3.75 cm (1.5 inch) with M.S. fixtures for clamping	1 No.

Appendix IV

Performance of pump using different impeller-diffuser assemblies

Head (m)	Impeller 1						
	Head on weir(cm)	Discharge (lps)	Voltage (V)	Current (A)	Input power(kW)	Output power(kW)	Efficiency (%)
0.57	43.20	521.31	350	50	25.76	2.91	11.30
1.32	43.62	530.20	360	60	32.24	7.01	22.00
1.58	43.54	528.68	360	55	29.15	8.18	28.06
2.13	45.52	528.44	360	60	32.24	10.35	32.10
2.51	40.30	470.80	400	70	37.10	11.58	31.07
3.13	35.00	380.99	400	65	34.45	11.02	32.00

Head(m)	Impeller 2						
	Head on weir	Discharge (lps)	Voltage (V)	Current (A)	Input power(kW)	Output power(kW)	Efficiency (5)
0.57	40.70	478.43	330	30	14.57	2.70	21.02
1.32	40.80	480.93	330	35	14.79	6.22	42.06
1.58	41.32	488.82	345	42	21.33	7.56	35.48
2.13	41.45	490.99	350	50	25.76	10.24	39.78
2.51	43.60	530.21	370	60	32.68	13.04	39.90
3.13	45.00	555.40	340	87	43.54	17.93	41.18

Head(m)	Impeller 3						
	Head on weir(cm)	Discharge (lps)	Voltage (V)	Current (A)	Input power(kW)	Output power(kW)	Efficiency (%)
0.57	39.03	448.72	330	30	14.50	2.60	18.00
1.32	39.16	450.96	330	35	14.79	6.00	40.09
1.58	41.59	493.64	340	35	17.51	7.65	43.60
2.13	44.10	540.33	345	42	21.33	11.27	52.43
2.51	45.29	560.82	350	50	25.76	13.79	53.55
3.13	45.88	571.81	380	60	34.06	19.31	56.69

Appendix V

PERFOMANCE EVALUATION OF PETTI & PARA

Head (m)	Discharge (lps)	Power input (kW)	Water horse power (kW)	Efficiency (%)
1.93	443	27.44	6.95	25.32
1.72	472	30.07	7.32	24.34
1.59	510	30.87	7.95	25.75
1.50	585	34.28	8.63	35.17
1.40	660	35.18	9.05	25.72
1.3	725	36.56	9.28	25.27
1.00	905	36.51	8.86	24.27

EFFICIENCY IMPROVEMENT OF AN AXIAL FLOW PROPELLER PUMP INSTALLED AT KADUMPATTUPADAM KOLE PADAVU, THRISSUR

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ABSTRACT

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Abstract

In this study, the axial flow propeller pump installed at kadumpattu padam kole padavu, Karalam, Thrissur were studied in detail and its efficiency and discharge were found out at varying head and voltage conditions. The experiment was conducted by regulating the inflow of water by using a wooden sluice valve installed at the centre of temporarily constructed earthen bund at the inlet side of the impeller. A rectangular weir was installed at the canal about 1.5 m from the discharge end of the delivery pipe for measuring the discharge of the pump. The input energy was calculated using the energy meter fitted in the electrical panel. Study was also carried out to find the improvement in efficiency and discharge due to changing impellers and introduction of a diffuser immediately after the impeller in the delivery pipe. Accordingly the most suitable impeller-diffuser combination (Impeller-3) was selected as its efficiency was 56.69% with a discharge rate of 571.81 lps at head of 3.13 m. A miniature model of the pump was fabricated and tested at hydraulics lab of KCAET, Tavanur to analyze the changes of discharge at laboratory conditions.