

Use of Water Powered Pump for Free Irrigation Purposes

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Abstract

Water Powered Pump (WPP) is a new invention for the world. WPP uses kinetic energy of the stream water. WPP does not require any electric energy, petroleum products such as diesel fuel, gasoline or natural gas. The water powered pump will be used for supplying water for irrigation, domestic or other requirements. WPP is environmental friendly product and converts the unused kinetic energy of the stream water for pumping a certain volume of water to a calculated head. The capacity of the WPP depends on the stream water volume, drop height, pumped water volume, pumped height and system efficiency. WPP completely differs from water hammer and other type of centrifugal pumps. WPP is eliminating irrigation pumping cost which becomes a big burden on the farmers' budget. The new invention is an environmental friendly product and helps the reduction of global warming by using kinetic energy of the stream water.

Keywords

Renewable energy, water and food

1. Introduction

WPP uses only kinetic energy of the stream water. The capacity of the WPP depends on the stream water volume, drop height, pumped water volume, pumped height and system efficiency. The capacity of the WPP shall be calculated by using mathematical, mechanical and hydraulic formulas. Water hammer has been invented in the last century for pumping water to higher elevations by using kinetic energy of the stream water. The capacity of the water hammer is limited and is not very effective for high elevations. Water hammer has not been widely used in the world, because of the limited capacity.

Kinetic of the stream water has been used for the pumping the water to high elevation by the many researches. Water hammer or similar devices have been invented in the past [1], [2], [3], [4], [5] and [6] by the different inventors or scientists. They were not very successful because of low efficiency, low capacity and small pumping head. WPP completely differs from the old inventions.

WPP completely differs from water hammer and other type of centrifugal pumps. WPP has a water turbine (water wheel), which is directly connected to a piston system. The stream water rotates the water turbine and circular movement changes to a vertical movement by a crank. The WPP sucks and pushes the water to regulation tank by two sided acted pistons without stopping. The air tank prevents cut flows of the water in push pipe and eliminates the water hammer back pressure. Outlet of the water comes from the air tank by the push pipes.

The water turbine and WPP are directly connected to each other and the loss of the system decreases while the productivity of the WPP increases. The volume and drop height of the stream water, affects the pumping head and pumping water volume. These four parameters relations were being calculated by using physical, mechanical, hydraulic and mathematical formulas. The water turbine and WPP dimensions have been calculated by using stream water data and pumping water head and volume. The total system efficiency is also affecting the WPP effectiveness. WPP is simple device and it doesn't need complicated electronic and high-tech parts and materials. WPP is made of steel plates, iron bars, valves, bearing, miles, pipes and, an air tank and chase. Most of the parts have been connected to each other by

welding or screws.

2. Methods

Development of WPP took a long time research and investigation. There is not any similar pump in the world now. Some similar devices have been invented last century. None of them has not reached the WPP pump height and capacity. WPP pump height and capacity will be increased by additional research and study. The inventor developed and invented WPP by himself in Ankara, Türkiye. So, any outside technical and financial help or contribution have not been achieved from any government or private organizations during the production. WPP's have been produced in Kahramanmaraş Province Elbistan town and Industrial Center of Ankara (OSTİM) by instruction of the inventor.

WPP can be used on the water stream and creeks with a drop. The capacity of the WPP depends on the stream water volume, head (drop height), pumped water volume, pumping head and system efficiency. The WPP capacity and dimensions can be designed according to topographic conditions of the area, stream water capacity, drop height and pumping head. There is a linear relation between stream water volume and drop head. If one of the parameters is increased the power of the turbine would also increase. An inverse ratio exists between WPP volume and pumping height. These four variable parameters and the system efficiency affect the WPP dimension selection criteria. Since the power is constant, if the pumping water volume increases, the pumping head would be reduced. These five parameters relations define the WPP capacity design and implementation criteria.

The WPP pump uses kinetic energy of the stream water and is a self-operated pump. If a farmer uses electric energy for pumping the irrigation water, instead the WPP pays back its investment cost in one irrigation season, approximately in 6-7 months in Turkey. If a farmer uses diesel engine and diesel fuel, instead WPP pays back its investment cost in 4-5 months. Many farmers are using electrical driven centrifugal pumps, diesel motor or PTO of the tractors for providing irrigation water to their fields. The farmers who are using pumps for irrigation in Turkey have been given Table 1.

Table 1. Irrigation Pump User' Farmers in Turkey

Pump Users For Irrigation	Number	%
Electrical driven pump user	213.926	42.9
Diesel motor driven and pump user	192.579	35.6 (12-16 HP diesel motor)
Tractor PTO driven pump user	116.182	21.5 (40-70 HP diesel motor)
TOTAL	540.689	100.0

Source: Turkish Statistical Institute (TUIK), 2020.

Totally 540.689 farmers are using centrifugal pump for providing irrigation water to their lands. They are using electric energy, diesel motor and diesel fuel. If the farmers are using electric energy for the pumping the irrigation water, they are spending minimum 3.000 \$/per farm/year. The estimated annual electric energy cost will be approximately 1.62 billion Dollars per year in Turkey. Electric energy cost is very important and covers almost 81.6% of the expenses for the pumped irrigation water. The pumped irrigation projects cot share has been given Table 2.

Table 2. Pumped Irrigation Projects Cost Share in DSİ Projects in Turkey

Items	%
Pumped irrigation water energy cost is	81.6
Staff salary	10.1
Maintenance and overhauling	7.0
Other expenses	1.3
Total	100.0

Source: General Directorate of Hydraulic Works (DSİ), 2019.

Average electric energy consumption is more than 2.000 kWh/ha in government pumped irrigation projects in Turkey. This amount is changing between 1.000-4.000 kWh/ha based on pumping head. Some projects electric energy use is more than 3.000 kWh/ha because of two or three stages irrigation water pumping.

If the farmer is using diesel fuel this cost increasing approximately 70% because of high diesel fuel cost in Turkey (diesel fuel cost is 0.8 \$/liter). These energy cost is a burden on the farmers. WPP is [eliminating this energy cost and providing irrigation water free of cost. WPP sustain the agricultural production without any cost during the service life.

A “Water Powered Pump” book has been published by Lambert Academic Publishing Company- Berlin, in Germany in January-2019 WPP Book ISBN- 978-613-9-98567-8 [7]. The WPP book that has 93 pages gives all the details of WPP technical specifications and implementations. The WPP book includes information about energy needs and using renewable energy for irrigation, WPP working conditions, main parts of WPP, calculations of water volume, implementation of seven sites information, energy gaining for each implementation, tables, graphs, charts, diagrams and implementation site pictures.

Efficiency of WPP has to be increased in some cases. The efficiency of the WPP has not known for the high elevations pumped head. The maximum pumping head was 150 m. elevation, and 1.400 m. distance has been achieved in Mersin Province, Mut Town Çömelek Village by 3.0 inches diameter pipe in 2013.

Some farmers and rural committee members want to pump the irrigation and domestic water supply up to 200-300 meters elevation. Theoretically it seems it is possible to pump the water to that elevation. If the stream capacity and drop height are sufficient, 200-300 even more elevation what type of technical problems will happen are not known yet. Additional research and study should be carried out by an experienced team with the contribution of inventor.

The WPP pump has some advantages have been summarized as follows:

- WPP does not need a diesel or electric driven motor. So, it does not need diesel fuel, gasoline, natural gas, fossil fuel and electricity. Energy cost of the WPP pumped irrigation or domestic water supply is equal to “zero”.
- WPP provides water for agricultural and domestic usage and can be used also for the recreational purpose.
- WPP is suitable for implementation of trickle and sprinkler irrigation method.
- WPP works 24 hours a day without stopping.
- WPP does not require any high techniques or electronic parts.
- The patent right has been taken by Mr. Şahin Bekişişođlu in July 2012. Turkish Patent Institute (TPE) patent number is: TR 2005/ 05074 [8].
- USA-Registration number: Water Powered Pump by sahin bekisoglu WO 2007 073358 A1 [9].
- Europe WIPO: PCT /TR 2006/ 000066 [10].
- Production, assembling, maintenance and operation of the WPP are easy.
- WPP does not need any additional expenses during the working period.
- WPP first installment cost is not very high.
- WPP maintenance is easy and does not require any high technology.
- WPP operation and maintenance costs are minimized.
- WPP has a long service life (minimum 20 years).
- WPP provides water for the high elevation by free of charge.
- WPP can be used for providing domestic water and irrigation water where the rural electricity does not exist.
- WPP does not have any negative effect on the environment.
- WPP eliminates carbon emission and protects the world from global climate changes.
- WPP can be used for forest fire extinguish by collecting water in a pond on a high hill during the rainy season. This stored water can be used by water trucks or helicopters during the fire.

WPP have some disadvantages:

- WPP can't work in lakes and reservoirs. WPP cannot work in stagnant water.
- Flood possibility should be taken into consideration during the installment.
- The stream water drop head should be 0.5 m. and even more.

3. Main Formula of Water Powered Pump

Water powered pumps needs stream water. The capacity of the stream water for WPP has to have at least minimum 30 liters/second. If the stream water capacity increases, pumped water capacity and pumped elevation also increases.

WPP have four different types. Undershot type WPP can works minimum 0.5 m. stream water drops. Overshot WPP can work minimum 0.6 m. stream water drop. Overshot WPP efficiency is more than that of undershot WPP type. WPP working conditions have been given as schematic diagrams on Figure 1, Figure 2 and Figure 3.

Total stream water capacity	: Q_a (liters/second)
Stream water capacity not to use by WPP	: Q_d (liters/second)
Water which has been taken for WPP	: Q_1 (liters/second)
Water has been taken for the pump	: Q_2 (liters/second)
Water has to be pumped from tank to push pipe	: Q_3 (liters/second)
Remaining stream water flows to the course	: Q_k (liters/second)

Stream water can be taken totally (Q_a) or partly taken (Q_1) by an earth channel, flumes or by a penstock to WPP turbine. The remaining water (Q_k) can be flown to the stream course.

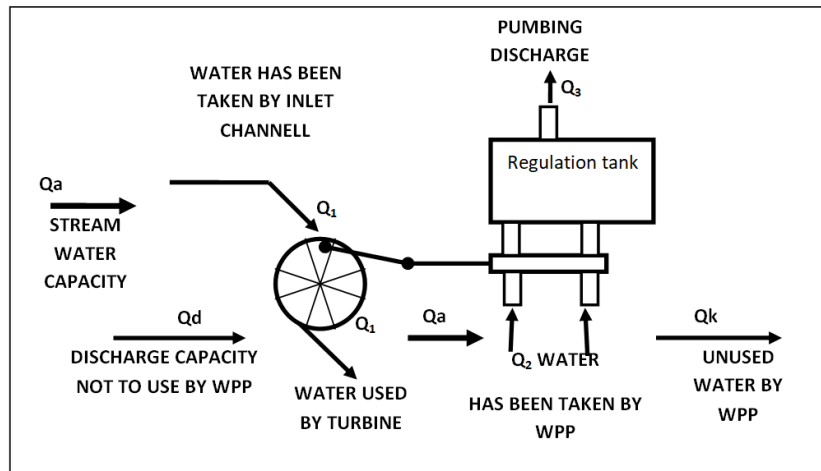


Figure 1. Overshot Water Powered Pump.

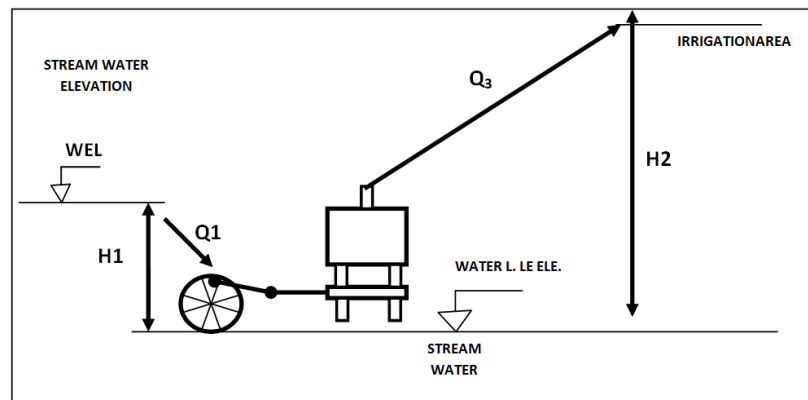


Figure 2. Overshot Water Powered Pump Schematic Diagram.

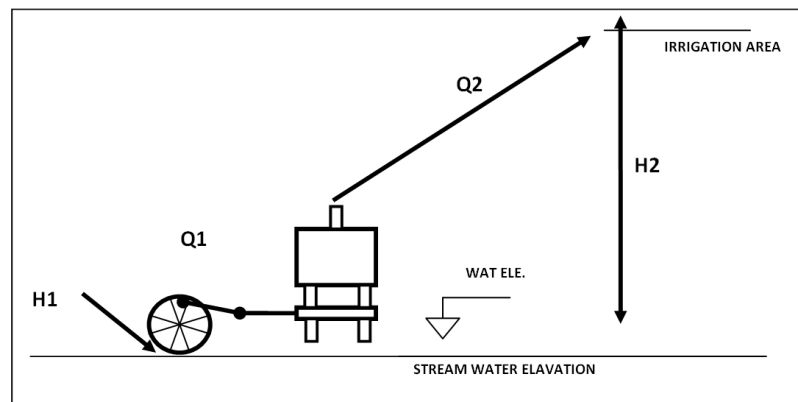


Figure 3. Undershot Water Powered Pump Schematic Diagram.

Q_1 : Stream water capacity (liters/second) ; Q_2 : Pumped water capacity (liters/second)
 h_1 : Drop head (m) ; h_2 : Pumped water elevation (m)
 μ : Efficiency (30-50%) ; $Q_1 \cdot h_1 \cdot \mu = Q_2 \cdot h_2$

If the water elevation is not very high, undershot WPP can be applied. In this case, WPP efficiency decreases in some amount. Estimated efficiency probably will change between 30-50%. There has not been any implementation undershot type WPP.

Stream drop height, pumping water volume and pump head have been calculated by using graphs and computer program, developed for this invention. WPP is designed in 4 different types, namely vertical, horizontal, and submersible and bottom flow types. The WPP pump uses kinetic energy of the stream water and is a self-operated pump.

4. Results

WPP has been implemented successfully couple of places in Turkey. The first implementation has been achieved in a farmer field in Malatya Province Doğanşehir Gövdeli town in 2008. The drop height of the stream water was only 1.5 meter and stream capacity was 100 liters/second. $Q=200$ tons/day ($200 \text{ m}^3/\text{day}$) irrigation water has been pumped up to 45.0 meters elevation, 350.0 meters distance by using the WPP. The farmer is irrigating two hectares cherry trees and family vegetable garden (a movie can be seen at you tube –sugucüpompasi).

WPP has worked without any breakdown and failure in the past. The farmer's profit was approximately 191.0 \$/month. The farmer did not pay totaling 1.146 \$/year ($191.0 \text{ $/months} \times 6 \text{ months}$) for supplying irrigation water for his agricultural fields in years (electric energy price is 0.11 \$/kWh in the country).

The second implementation has been done in Kayseri province Sarız district Yaylacı village in April 2010. Picture [1], [2], [3]. The project has been supported by United Nations Ankara Office. The drop height of the stream water was 5.0 meters, capacity 400.0 liters/second. WPP is pumping 19.0 liters/second ($68.0 \text{ m}^3/\text{hour}$) irrigation water, totaling 1.640 tons/day (m^3/day) water up to 54.0 meters. This amount of irrigation water will be sufficient approximately 30,0hectares' agricultural land or 11.000 people's domestic supply (150 liters/ person/day).

The farmers' implemented 2.0 hectares' trickle (drip) irrigation, 7.0 hectares' sprinkler and 2.0 hectares' surface irrigation method in their fields. The farmers are irrigating orchard (apple tree), alfalfa, potatoes, wheat and vegetables. Annual energy cost saving is approximately 12.000 \$/year or 15.0 tons' diesel fuel. WPP pumping cost is "zero".

A movie can be seen in web page: www.sugucupompasi.com or if you write GOOGLE "water powered pump implementation in Turkey", you can watch movie on you tube- In English. If you write GOOGLE Sugucu Pompasi, you can watch Turkish Language movies on you tube).

WPP has been implemented in Mersin province, Mut town Çömelek village in May 2013. The pump height was 150.0 meters and the distance 1.400,0 meters. The stream water capacity was 300.0 liters/second and drop height was 5.0 meters. The pumped water capacity by WPP is $8.0 \text{ m}^3/\text{hour}$ ($28.8 \text{ m}^3/\text{hour}$). Yearly energy saving cost is 15.000 \$/year. Using diesel pump is non economically in Turkey because of high diesel fuel cost. Water Powered Pump (WPP) Implementations and Energy Cost is "zero".

Another WPP implementation has been done in Karabük province, Eskipazar town Yazıboy village in May.27.2014. Picture [4], [5], [6]. The pumping height was 80.0 meters and the pumped water distance 500.0 meters. The stream water capacity was 250.0 liters/second and drop height was 7.0 meters. WPP is working quite effectively and pumping the irrigation water up to 80.0 meters now. The pumped water capacity by WPP is $36.0 \text{ m}^3/\text{hour}$. If the farmers were using electrical driven pump, the yearly energy cost will be equal: $30 \text{ kWh/hour} \times 24 \text{ hour} \times 150 \text{ day} = 108.000 \text{ kWh/year}$. WPP energy cost is "zero".

Erzurum province, Oltu town Kesikköprü Farm implementation has been done July.18.2017. Picture [7], [8], [9], [10]. The pumping height was 91.0 meters and the pumped water distance 700.0 meters. The stream water capacity was 200.0 liters/second and drop height was 3.50 meters. WPP is working quite effectively and pumping the irrigation water up to 91.0 meters now. The pumped water capacity by WPP is $18.0 \text{ m}^3/\text{hour}$. WPP energy cost is "zero". Annual energy saving is \$ 4.680 in a year. Five hectares sprinkler irrigation method has been applied on the agricultural land.

Another implementation has been done in Ankara University Agricultural College field in Ankara in April 2015. The circulated water capacity was 30.0 liters/second, the drop height was only 1.70 m. WPP is working quite effectively and pumping the irrigation water to 0.2 ha land. The drip irrigation method has been achieved for 0.2 ha vegetable garden. One sprinkler head is working at the same time.

5. Discussion

Water powered pump converts the dry farmland to irrigated land without any energy cost if a stream water course exists. The farmers increase their income by production of vegetables, fruits, fodder for animals. If the climatic conditions are suitable the farmers can get two may be three crops in a year.

Irrigated agriculture creates additional job facilities for the workless people. Earthworks, planting, seeding, irrigation, plant protection, harvesting, scaling, packing and marketing need additional work force. Family work force and hired workers capacity and efficiency will increase during the irrigated agriculture. As a general rule, irrigated agriculture needs 2-3 times more work force than the dry land farming.

Turkey has 177.000 km long stream water course in the country. The world has more than 10 million kilometers stream water courses in the different countries. WPP can be used not only in Turkey but also in many countries in the world.

WPP can be used in the world effectively for the providing irrigation and domestic water for the rural areas which don't have rural electric lines. Millions of the poor people don't reach irrigation water and clean domestic water. WPP will make some contribution eradication of poverty by converting dry land to irrigated land. The farmers will have a

chance to raise different vegetables, fruits, fodder and field crops in their agricultural land.

Production of the different crops will increase the health capacity of the family member by consuming vegetables and fruits. Production of fodder especially alfalfa will increase milk, cheese, other dairy products and meat production by free of energy cost. Raising corn, making corn silage definitely will increase milk production.

The mountain areas will use water powered pump for the pumping the irrigation water to high elevation and store in a pond for the dry season use. Kayseri Province Sarız town Yaylacı village WPP capacity is 68.0 m³/hour, 50.000 m³/month. This amount of water can be collected in pond for couple of months. Later on this water can be used by drip or sprinkler irrigation method for the agricultural fields. Some villages' settlers may share this irrigation water by creating irrigation cooperatives.

WPP can be used for extinguish forest fires. There is so much water is running during the rainy season in the forest areas. Water can be pumped 200-300 m. even more elevation during the rainy season and collect a pond. Helicopters and fire trucks may use this water during the forest fire for the extinguish it.

Customers of WPP are the farmers which have no government irrigation network on their fields. Hundreds of farmers requested WPP in this year in Turkey. Azerbaijan, Uzbekistan, Kyrgyzstan and Bangladesh companies or individual farmers requested WPP in last and this year. The inventor was not able to match these requests because of his financial constraints. The inventor doesn't do mass production of WPP now.

The inventor spent 13 years' time and \$ 80.000 (U.S. Dollars) from his pocket. He doesn't have enough capacity for the standardization and mass production of the WPP.

- WPP needs additional research and study for increasing the efficiency during the mass production. Efficiency is approximately 50% now. The efficiency should be raised up 60-70%.
- WPP needs standardization such as 1", 2", 3", 4" and 6" (inch) suction and push pipe diameter.
- WPP is not a small pumping system. One inch capacity WPP weight will be around 400- 500 kg, 6 inch capacity WPP weight will be around 3.500-4.000 kg. Kayseri Province Sarız town WPP weight is approximately 3.500 kg. The chase length is 6.0 m, width is 1.6 m. and height is 2.5 m. The water turbine, pump system, sucking and pushing pipe, special valves, flume, air tank and chase total weight will be changed based on WPP capacity and implementation site specifications.
- Some special projects (200-300 meters' elevation) and big size WPP projects (30-75 liters/second capacity) cost will be calculated based on the site conditions, stream water capacity, drop head, pumping head, pumping distance and crop types.
- WPP efficiency has not known more than 150.0 meters elevation and 1.400 meters distance. Some farmers and settlements need 200-300 meters elevation and long distance. It should be tested.
- WPP needs financial support or some grants for the additional research, standardization and mass production. A businessman may want to create a joint venture with the inventor for the mass production of WPP.
- Many farmers want to buy WPP in Turkey. Electric energy and diesel fuel cost is very high in the country. Energy price also is getting higher in the world.
- WPP will be used and exported at least 70 countries in the world. Such as, Iran, Iraq, India, Pakistan, Nepal, Afghanistan, China, Mongolia, Middle Asia countries, Balkan countries, Russia, Ukraine, African countries, Mexico and South American countries.
- Many countries farmers are poor and they don't reach government irrigation project networks. Their land is so fragmented and very small. WPP will provide irrigation water free of charge mainly to these poor farmers. The WPP establishment sites farmers will increase their income within one irrigation season approximately 3-10 times when we compare the dry land farming. The farmers get on crop in a year in dry land farming. Some dry areas the land stay without crops as a follow. The farmers plant their agricultural land every year if the irrigation water available. They can raise different crops variety. This will increase different food consume variety and will help better living standards.
- In many countries, the farmers have small fragmented agricultural plots. Average farm size 6.0 ha in Turkey. Each farm has 5-6 small size fragmented land. Many countries farmers have 2.0-3.0 ha land. Mountains and forest area village settlers have approximately 1.0 ha agricultural land. If this area doesn't have irrigation water, it is not possible to make a good living on this small scale plot. If the farmland gets water, the land production and net income will increase approximately 3-10 times.
- Dry land unit price is always less than the irrigated land. When the dry land becomes irrigated land, its value is increasing 5-8 times.
- Our target is to increase these small scale farmers' net income. If a farmer pumps the 10.0 liters/second capacity irrigation water up to 50.0 meters, he has to use average 2.000 kWh/ha/year electric energy. The electric price is approximately 0.16 \$/kWh in Turkey for irrigation now.
- Energy price is increasing all over the world. So, irrigation pumping cost will increase the farmer net income will decrease. WPP is eliminating irrigation pumping cost. Many places in the world don't have rural electric

lines. WPP is very suitable for these areas if there is stream water. If you want to get electric lines to an agricultural land, you need to have a transformer, electric poles, cables, switch, and electrical driven centrifugal pump. These systems cost a lot of money. In addition, that, the farmer has to pay electric bill regularly. WPP doesn't need any of these systems.

- WPP is very suitable small size fragmented farm plots. One farmer may use WPP or group of farmers use the irrigation water collectively. WPP works day and night without stopping. The farmers may collect that water at night in a pond and use it in day time.
- Mass production of WPP will decrease the unit production cost. So, many farmers will buy WPP easily. The other possibility some parts may produce in Turkey and rest of the system can be produced in the local country.
- WPP will help increasing the whole family life standard. The vegetables, fruits, fodder will be raised in the irrigated land. Fresh vegetables and fruits will improve family diet habit and nutrition. The women will do tomatoes and pepper paste, pickle, pasteurized canned vegetables, dried tomatoes, red pepper, okra, eggplant and squash. All these dried vegetables will be consumed by the family members in out of season especially in winter. If the family has refrigerator some vegetables can be frozen. Sun dried vegetables and fruits can be consumed in winter time. Sun dried apricot, plump, mulberry, sour cherry and some other dry fruits will be consumed by the family members. The children and all the family member will have better quality food and nutrient on the table. The women will have selection about the cooking.
- Women may harvest some vegetables and fruits and sell them on the market. They can earn cash money and spend that money for the other needs. The women will have much benefit from WPP.
- The women are carrying domestic water by hand for cleaning, washing the dishes and for other daily use. WPP is providing irrigation water on the high elevation. The women will use that WPP pumped water and they become very happy.
- Some village settlers are paying electric energy bill every month for getting domestic water supply. This becomes a burden on the people.
- WPP will provide irrigation water and crop varieties will be changed. The women will have chance to cook different meals. The family nutrients and eating habit will be changed when the irrigation continues. These fresh vegetables production will have effect on the living standard of the family members and the women will have benefit from them.
- Many countries are importing petroleum products, diesel fuel or gasoline. All these countries are paying foreign currency for the importing the petroleum products. WPP will have some positive contribution to the country economy and farmer budget. This contribution will have much positive effect especially on farmers' net income. The farmers will not pay any pumping energy cost for abstracting irrigation water from the stream or a creek.
- WPP is an environmental friendly product and it will help reduction of carbon emission. WPP will have some contribution lesson the global warming. WPP is using small scale streams and creeks water and doesn't create carbon emission.
- Each WPP gets %5-10 of the stream water volume based on stream water capacity, drop head, pumping height, pumping water distance and irrigable land size. The remaining stream water flows in the stream course. More than one WPP can be established on the same stream.
- WPP will not have any negative effect on fish live and aquatic organism. It will not demolish and change the stream water quality. WPP can't use any petroleum products, machine oil, solvent and any other organic or inorganic substances.

6. Conclusion and Recommendations

The inventor was not able to do standard mass production now because his financial constraints. Turkish government organizations rejected WPP research, development mass project five times. The inventor's main goal is not to serve only his country people but also the whole world human. Many farmers are requesting WPP in and outside the countries. If the inventor provides some money from any source, he will open a big size workshop and do the mass production of WPP. He is waiting for an investor or an international grant for the additional research, standardization and mass production of WPP.

WPP has to be used for the benefit of the world farmers, rural people and human. Many successful implementations have been done by the inventor in Turkey. His financial capacity is not sufficient for the mass production of WPP. A businessman, a commercial company or any or a donor organization have to make some investments or contribution for the mass production of WPP. Otherwise, WPP will be a "dead baby".

7. Implementation Site Pictures



Picture 1. WPP is working in Yaylacı Village.



Picture 2. WPP Flowing water from pipe in to a concrete pond

Kayseri Province Sarız Town Yaylacı Village WPP Implementation, May 2010. Pumping height: 54.0 meters, pumping distance: 200.0 meters, pipe diameter: 6" (150.0 mm). Capacity: $Q = 19.0$ liters/second = 68.0 m³/hour = 1.632 m³/day = 48.960 m³/month



Picture 3. Kayseri Province Sarız Town Yaylacı Village.



Picture 4. Karabük Yazıboy Village

Karabük Eskipazar Town Yazıboyu Village WPP Implementation General View, Pumping height: 80.0 meters, distance: 500.0 meters, Capacity: 10.0 liters/second. A thirsty cow drinking water from pipe outlet.



Picture 5. Karabük Yazıboy Village.



Picture 6. Yazıboy Village A Cow Drinking Water.



Picture 7. Erzurum Province Oltu Town Kesikköprü Farm.



Picture 8. Irrigation Water.

WPP Implementation, July 18, 2017. Pumping height: 91.0 meters, distance: 700.0 m, Capacity $Q = 5.0$ liters/ second $Q = 18.0 \text{ m}^3/\text{second} = 432.0 \text{ m}^3/\text{day} = 12.960.0 \text{ m}^3/\text{month}$.



Picture 9. Dry Grass and Irrigation Water. July 17, 2017.



Picture 10. Green Grass Sprinkler Irrigation and Grazing Cows. September 25, 2017.

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