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The International Commission on Irrigation and Drainage (ICID), established in 1950 is the leading scientific, technical and not-for-profit Non-Governmental Organization (NGO). ICID, through its network of professionals spread across more than a hundred countries, has facilitated sharing of experiences and transfer of water management technology for over half-a-century. ICID supports capacity development, stimulates research and innovation and strives to promote policies and programs to enhance sustainable development of irrigated agriculture through a comprehensive water management framework.

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August 2019
PARTICIPATORY IRRIGATION MANAGEMENT: BARIND MODEL
A NEW SUSTAINABLE INITIATIVE

Dr. Asaduz Zaman1

ABSTRACT

During the past 20 years, substantial efforts were made to improve irrigation Management-Operation & Maintenance (MOM) through introduction of participatory irrigation management (PIM). PIM proved generally successful on small and medium schemes but it has yielded limited results on large schemes.

Stakeholder engagement in irrigation system shapes hydro-social territories: (1) by reducing tension between stakeholders, (2) by redirecting regional planning and strategy, (3) by highlighting water crises, (4) by decentralizing water responsibilities and (5) by integrating values and beliefs from different stakeholders. (Sandra Ricart, et.al., 2018)

Privatization started to become politically fashionable in the late 1980. In this context privatization means off-loading government ownership or responsibility for operation into the private sector, either to the farmers themselves or to an intermediate private subcontractor. But is it just a means of off-loading responsibility from a government line management system that can’t cope, or is it really to benefit the farmers? (Adrian Laycock, 2011)

Barind Multipurpose Development Authority (BMDA) is an autonomous authority. The BMDA does not require external finance to operate the irrigation project, and sustainable finance. There are around 16,000 deep tube wells and surface lift pumps covering around 0.6 million hectares (round the year) under BMDA management. BMDA is managed by a board chaired by an appointee of the government. There are three other members representatives from farmers including other relevant department’s representatives.

BMDA has introduced innovative concept for prepayment for water; this was started using a system of using electronic prepaid meters. There are no formal WUOs established instead keeps a very close liaison with the farmers and the communities through their field offices, this approach appears to be effective. The chief executive of a successful irrigation project should have a clear idea about people, land and water.

Keywords: Irrigation, sustainable management, self-Financed, Pre-paid meter and smart-card.

1. INTRODUCTION

1.1 Participatory Irrigation Management

J. Raymond Peter (Executive Director, International Network on Participatory Irrigation Management, Washington, DC) states the term participatory irrigation management refers to the participation of users-the farmers-in the management of the irrigation system. Further he refers the Handbook on PIM defines Participatory Irrigation Management as the involvement of the irrigation users in all aspects of irrigation management, and at all levels. All aspects include planning, operation and maintenance, financing, decision, rules and the monitoring and evaluation of the

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irrigation system. All levels include the primary, secondary and tertiary levels. In the governance paradigm, PIM can be considered as a partnership between governments, agencies and users. Mark Svendson and others stated Participation in irrigation management by water users can take a wide variety of forms. Farmers can be involved in various system management functions, planning, design, operations, maintenance, rehabilitation, resource mobilization, and conflict resolution. Moreover, they can be involved in these functions at various system levels; from the field channel to entire system. Almost all irrigation systems have some involvement by water users in system management. When people speak of introducing “Participatory Irrigation Management” (PIM), they are thus usually referring to a change in the level, mode, or intensity of such participation that would increase farmer responsibility in management process. PIM is designed to shift the financial burden for irrigation services from the agency to the users. This idea is being supported by Mr. Adrian Laycock, as he stated, Privatization started to become politically fashionable in the late 1980. In this context privatization means off-loading government ownership or responsibility for operation into the private sector, either to the farmers themselves or to an intermediate private subcontractor. But is it just a means of off-loading responsibility from a government line management system that can’t cope, or is it really to benefit the farmers?

1.2 Sandra Ricart and Others

show how stakeholder engagement in irrigation systems shapes hydro social territories: (1) by reducing tension between stakeholders, (2) by redirecting regional planning and strategy, (3) by highlighting water crises, (4) by decentralizing water responsibilities, and (5) by integrating values and beliefs from different stakeholders. Stakeholder engagement is one of the main characteristics of the shift from governmental to non-governmental ownership, management and administration of water resources and services. Stakeholder engagement implies a combination of collaboration—which involves cooperation to achieve goals of efficiency, equity and sustainability in water resources and comprehension—which is made up of forces, systems and mechanisms consisting of the ability to put oneself in the place of the other, sharing social identity, and promoting work together to achieve particular outcomes at different scales.

1.3 Analysis of PIM

A major weakness that continues to plague the productivity of large irrigation schemes is the lack of efficient and sustainable Maintenance Operation and Management (MOM). As a consequence, the infrastructure of these schemes is degraded and needs rehabilitation and modernization. Other reasons include inadequate Government financing, lack of beneficiary empowerment and engagement in MOM; and limited capacity of public agency resulting in weak service delivery. Specific issues are the: (i) inadequacy of budget to support system MOM; (ii) lack of distinction between annual, periodic or emergency maintenance of a system; and (iii) poor cost recovery from the water management groups Water management is very limited with minimal attention to how the scarce water resources are allocated and most schemes only meet a small portion of their target production. Many farmers turn to the use of groundwater to support limited and irregular water supplies. The mix of irrigation from surface and groundwater makes evaluation difficult and masks deficiencies of the surface water supplies.

During the past 20 years, substantial efforts were made to improve irrigation MOM through introduction of new model of participatory irrigation management (PIM). PIM proved generally successful on small and medium schemes but it has yielded limited results on large schemes. The variable performance of PIM in improving irrigation MOM is internationally documented and private sector participation through public private partnership (PPP) is seen as an interesting alternative approach. It has
demonstrated promising results in few developing countries such as Brazil, Morocco and Ethiopia but is still to be developed in Asia. The irrigation systems in Asia are characterized by densely populated farmers doing subsistence agriculture. The farm size among Asian farmers, are small as opposed to large commercial farms in the west, farmers are generally poor and usually augment incomes through non agriculture related activities. Inequities among farmers in terms of farm size, access to credit and markets, caste structures make irrigation in Asia very complex. However, in Bangladesh this issue of cast structure is not evident especially in irrigation sector.

1.4 Water User Association (WUA)

There are Water User Association (WUA) and cooperative groups in government documents but practically is not in effective form especially in most the irrigation schemes in South East Asia. If there is any WUA in any irrigation scheme -that is only in paper. If one asks the farmers, the president or secretary of the WUA are for how many years- the reply would be from the beginning of formation of WUA. The problem is the stake holders as farmers are of very heterogeneous – there are rich and poor farmers, educated and illiterate farmers, own land owners and share croppers or lessee farmers. Practically, it is quite critical issue. Moreover, this Water Users Association is advocated by most of the studies but possibly one aspect is overlooked or bye-passed, the remunerations to office bearers of the WUA. How one can expect they will render their services properly? It is believed those office bearers of WUA or so called cooperatives manage certain benefits monetarily or other ways ( own land irrigated by the cost of other water users). However, this unholy practice is being followed in most of the WUA and cooperatives of irrigation schemes.

2. BARIND MULTIPURPOSE DEVELOPMENT AUTHORITY (BMDA)

The Barind Multipurpose Development Authority (BMDA) is an autonomous authority reporting to the Ministry of Agriculture. BMDA has taken an innovative approach to management of rural infrastructure, particularly the distribution irrigation water and management of irrigation systems. The part of greater Rajshahi, Dinajpur, Rangpur and Bogra District of Bangladesh and the Indian territorial Maldah District of West Bengal is geographically identified as the Barind Tract. The hard red soil of these areas distinguishes it from the other parts of the country. A typical dry climate with comparatively high temperatures prevails in the Barind area from November to May. The total cultivable area is 600,000 ha of which 84% is single-cropped,13% is double cropped and the rest is triple cropped. The Barind Multipurpose Development Authority (BMDA) was established under the Ministry of Agriculture in 1992 through the Secretarial power of the concerned Ministry. However, Parliament passed the Act in October 2018 and now covers 16 districts; 124 upazilas, 1,094 unions, and 20,153 mouzasi.e. whole of Northwest part of Bangladesh shown in figure 1.

Figure 1: Map of Barind Authority.

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2.1 BMDA Management

BMDA is managed by a board chaired by an appointee of the Prime Minister. The Executive Director (Chief Executive Officer) of the Authority is a member and also secretary of the Board. The Board is constituted as follows:

I. Chairman – Appointed by Prime Minister
II. Member - Deputy Inspector General of Police, Division
III. Member - Deputy Commissioners of the districts
IV. Members - Three members representatives from the farmers
V. Member Secretary - Executive Director, BMDA.
VI. Advisor - Members of the Parliament of BMDA jurisdiction

2.2 Irrigation Development

There are around 16,072 number of irrigation equipment (Tubewell-15,553 and Surface Water lift pump-519) under BMDA management and all are governed by BMDA Zone (field) Offices. Most important aspect not a single irrigation equipment is in idle condition for technical, financial or political reasons. BMDA pays employee salary, wages, all allowances, retirement benefits, and support costs for its around 1,036 regular staff members, 375 Muster roll staff and 1,6072 nos. of pump operators on hourly basis (no work no remuneration) i.e. total around 17, 483 engaged manpower, O&M costs of all irrigation equipment and transports, irrigation equipment’s electricity bills. BMDA bears all the above costs without seeking unreliable funding sourced from the Government. The detail of irrigation equipment and its use is shown in table no.1.

Table 1. Status of present irrigation equipment and its use

<table>
<thead>
<tr>
<th>Year</th>
<th>Used nos. of irrigation equipment</th>
<th>Total nos. of irrigation equipment</th>
<th>Irrigated area (Ha.)</th>
<th>Realized Irrigation Charges (Million BDT)</th>
<th>Realized Irrigation Charges (Million USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018-19</td>
<td>15,553</td>
<td>519</td>
<td>16072</td>
<td>540240</td>
<td>1561.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19.52</td>
</tr>
</tbody>
</table>

However, the year wise use of number of irrigation equipment and corresponding irrigated area are shown below in the graph, figure 2.

Figure 2. Year wise Deep Tube Well and Irrigated Area (Hecto)
3. PREPAID METERING SYSTEM & SMART CARDS

Despite its success, BMDA does not follow the principles of the Guidelines for Participatory Water Management (GPWM) nor does it follow the participatory processes that global lessons claim are necessary for sustainability. A significant feature of the BMDA operation is the pre-payment, by farmers, for irrigation water.

In response to the universal concern for irrigation sustainability, that O&M will fail through a lack of user raised funding, BMDA has introduced two innovative concepts for collection of the irrigation charge (IC) - a prepaid metering system.

The Prepaid Metering System provides every farmer with a user card. The user card, provided by BDMA has photo ID, name and a user number. The card is loaded with credit by paying cash at any BMDA office, or to an accredited dealer. The card is then inserted in a slot at the pump station and water is pumped automatically with the charge levied against the credit on the card. The meter, usage and pump delivery is checked every one or two days by a BMDA official in a similar manner as for the coupon system. Card uploading stations (vending stations) are connected electronically to a central BMDA operator and all data can be monitored remotely. The process works using technology similar to that used for loading credit to cell phones. The initial concern for the introduction of a high technology electronic system was dismissed on viewing the system in operation. Farmers were using the card with confidence and the procedure was working. It fails when there is no electricity, but then so do the electrically powered pumps.

3.1 Mode of Operation of Prepaid Meter & Card

- Each farmer is issued with a pre-paid User card which when introduced into a pre-paid Meter enables the pump to start and water delivered until such time as the card is removed or its credit expires. The amount debited to the card is proportional to the pumping duration and therefore volume.
- Farmers recharge their cards using a hand held Mobile Vending Unit (MVU) kept by a Dealer who collects farmer payments. The Dealer recharges his MVU credit whenever required from a Vending Station (VS) at the local BMDA office after depositing the recharge amount into the BMDA bank account.
- The prepaid meter system which currently extends over 16 districts is managed by BMDA. Repairs to the system, for example for the 16,072 Meters, are done under contract with a private company (currently Sanakosh Associates Ltd). The system was supplied and installed by Wasion Group, China.
- All the pumps under BMDA are electric pumps. There are issues of reliable electricity but the farmers manage an informal backup system pumping from
ponds and khals. Farmers understand the limitations of electricity and some schemes are not fully planted due to the limitations of the number of hours of electricity.

3.2 Benefits of Pre-Paid Meter and Smart Card

- All water provided is paid for in advance;
- there is no opportunity to by-pass the meter;
- the system is completely transparent with checks and balances in place to counter fraud;
- People cannot coerce the operator to deliver water free of charge; and
- Farmers cannot be exploited by land owners who may control the well.
- Prepaid water charges go to BMDA coffers which support the sustainability of the BMDA

The findings of benefits after installation of Pre-Paid meter could be seen in the following table no.-2.

**Table 2.** Findings of benefits after installation of pre-paid metering system.

<table>
<thead>
<tr>
<th>Component</th>
<th>Without Pre-Paid Meter</th>
<th>With Pre-Paid Meter</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation Cost/ Ha. (BDT)</td>
<td>11,040</td>
<td>5,440</td>
<td>51% improvement</td>
</tr>
<tr>
<td>Irrigation Cost/ Ha. (USD)</td>
<td>138</td>
<td>68</td>
<td>51% improvement</td>
</tr>
<tr>
<td>Average Water use/ Ha. (Inch)</td>
<td>82</td>
<td>59</td>
<td>28% improvement</td>
</tr>
<tr>
<td>Water Required /Kg of Boro Rice production (Liter)</td>
<td>3400</td>
<td>2250</td>
<td>34% improvement</td>
</tr>
<tr>
<td>Avg. Yield / Ha. (Kg)</td>
<td>6.084</td>
<td>6.602</td>
<td>34% improvement</td>
</tr>
<tr>
<td>Avg. Earning /Ha. of Boro Rice (BDT)</td>
<td>31,200</td>
<td>44,480</td>
<td>43% improvement</td>
</tr>
<tr>
<td>Avg. Earning /Ha. of Boro Rice (USD)</td>
<td>390</td>
<td>556</td>
<td>43% improvement</td>
</tr>
</tbody>
</table>

3.3 Impact of Prepaid Metering System and Smart Cards

Analysis of different parameters of irrigation system shows a miraculous picture after installation of prepaid metering system and smart cards. The following table no.3and show the impact before and after installation of prepaid meters.

**Table 3.** Impact Before and After installation of Pre-Paid Metering System.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Before Pre-Paid Meter</th>
<th>After Pre-Paid Meter</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigated area / Well in Ha</td>
<td>30</td>
<td>39</td>
<td>30% increase</td>
</tr>
<tr>
<td>Nos. of water users/ Well</td>
<td>70</td>
<td>89</td>
<td>27% increase</td>
</tr>
<tr>
<td>Irrigation Charges/ Well in BDT</td>
<td>254,960</td>
<td>286,560</td>
<td>12% increase</td>
</tr>
<tr>
<td>Irrigation Charge/ Well in USD</td>
<td>3,187</td>
<td>3,582</td>
<td>12% increase</td>
</tr>
<tr>
<td>Annual operating hours /Well (Avg.)</td>
<td>2,884</td>
<td>3,132</td>
<td>9% decrease</td>
</tr>
<tr>
<td>Annual Electricity Bill /Well in BDT</td>
<td>129,040</td>
<td>117,360</td>
<td>9% decrease</td>
</tr>
<tr>
<td>Annual Electricity Bill in USD</td>
<td>1,613</td>
<td>1,467</td>
<td>9% decrease</td>
</tr>
</tbody>
</table>

4. ASSESSMENT OF IRRIGATION CHARGES

The irrigation charges per irrigation equipment under BMDA management are calculated by a committee of engineers. The committee calculates and recommend for consideration of the BMDA board. Once BMDA board approves the rate of irrigation charges, the same become effective for implementation in the field. The rate of irrigation charges to be such that all with the intention to keep Barind Irrigation as a sustainable model and different stakeholders feel satisfied. However, the following parameters are being considered for the assessment of irrigation charges.

Irrigation Charge = EC + POR + RMC + MCB + DC + SO + MVC + VAT
Where,

EC = electricity cost per hour KWh
POR = pump operator remuneration
RMC = repair and maintenance cost
MCB = maintenance cost of buried pressure pipe system
DC = depreciation cost of machine and equipment
SO = scheme operational staff cost
MVC = mobile vendor’s commission
VAT = Value Added Tax

The present rate of irrigation charge as been assessed and approved for irrigation equipment as are follows. The per hour irrigation charges are as follows for ground water lifting and surface water lifting and those are variable on the basis of discharge from the pumps are shown in table-4A and table-4B. Per hour irrigation charge is dependable on main aspect i.e. rate of electricity tariff.

**Table 4A. Present rate of irrigation charges per hour for Tubewells pumping**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Varied Discharge capacities for Tubewells</th>
<th>14 Lt./Sec.</th>
<th>15 to 21 Lt./Sec.</th>
<th>22 to 28 Lt./Sec.</th>
<th>29 to 56 Lt./Sec.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per Hour Rate in BDT</td>
<td>Tk. 85/</td>
<td>Tk. 100/</td>
<td>Tk. 110/</td>
<td>Tk. 125/</td>
</tr>
<tr>
<td></td>
<td>Per Hour Rate in US$</td>
<td>$1.06</td>
<td>$1.25</td>
<td>$1.37</td>
<td>$1.56</td>
</tr>
<tr>
<td></td>
<td>Price per 1000m^3 in BDT</td>
<td>Tk. 1687</td>
<td>Tk. 1323</td>
<td>Tk. 1091</td>
<td>Tk. 620</td>
</tr>
<tr>
<td></td>
<td>Price per 1000m^3 in US$</td>
<td>$21.08</td>
<td>$16.54</td>
<td>$13.64</td>
<td>$7.75</td>
</tr>
</tbody>
</table>

**Table 4B. Present rate of irrigation charges per hour for surface water lift pumping**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Single Lift Pumping 28 to 56 Lt. / Sec.</th>
<th>Double Lift Pumping 28 to 56 Lt. / Sec</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per Hour Rate in BDT</td>
<td>Tk. 125</td>
</tr>
<tr>
<td></td>
<td>Per Hour Rate in US$</td>
<td>$1.57</td>
</tr>
<tr>
<td></td>
<td>Price per 1000m^3 in BDT</td>
<td>Tk. 1240.00</td>
</tr>
<tr>
<td></td>
<td>Price per 1000m^3 in US$</td>
<td>$15.50</td>
</tr>
</tbody>
</table>

**Note:** i) Effective from 1st February, 2018  ii) 1 USD equals 80 BDT

5. **FINANCIAL VIABILITY**

Financial viability of irrigation project is the key factor for achieving the sustainable irrigation management system. The following tables nos. 6 and 7 shows the revenue earnings and expenditure for the year 2017-18. The chart in the table-05 shows the year wise earnings vs expenditures of the authority. Regarding financial viability Dr. Tushaar Shah who wrote in one of his publication after visiting and interviewing the farmers in 2014, "The revenue s earned are used for O&M and for expanding the system. Studies suggest that this system is financially self-sustaining. …The institutional arrangement is incentive -compatible. The Barind’s socio-economic impacts are deep and wide. In a region where farmers found it hard to grow one crop, today they grow up to three crops annually. Some 1.5 million small farmers have benefited and many more will benefit when the remaining 450,000 ha are brought into the tubewell programme." Similarly, Tonkin + Taylor did a field study of Barind in 2016 under Swiss Red Cross sponsorship and wrote “ BMDA in Barind has a highly capable and well organized management system with 100% revenue return on water pricing.” These all study reports show that Barind Irrigation Management system is a self-sustained model. The curve shown in the following graph in the figure 3 shows the year wise revenue earnings and expenditure of BMDA.
Figure 4. Year wise revenue earning vs expenditures.

Table 5: Statement of Revenue earnings of BMDA -Financial Year 2017-18.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Revenue (USD)</th>
<th>Total Operating Expenses (USD)</th>
<th>Total Savings (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001-2002</td>
<td>37.64</td>
<td>29.16</td>
<td>8.48</td>
</tr>
<tr>
<td>2002-2003</td>
<td>52.64</td>
<td>35.35</td>
<td>17.31</td>
</tr>
<tr>
<td>2003-2004</td>
<td>63.00</td>
<td>56.20</td>
<td>6.80</td>
</tr>
<tr>
<td>2004-2005</td>
<td>63.38</td>
<td>50.80</td>
<td>12.58</td>
</tr>
<tr>
<td>2005-2006</td>
<td>96.01</td>
<td>58.60</td>
<td>37.41</td>
</tr>
<tr>
<td>2006-2007</td>
<td>78.63</td>
<td>66.87</td>
<td>11.76</td>
</tr>
<tr>
<td>2007-2008</td>
<td>102.51</td>
<td>84.79</td>
<td>17.72</td>
</tr>
<tr>
<td>2008-2009</td>
<td>123.20</td>
<td>118.75</td>
<td>4.45</td>
</tr>
<tr>
<td>2009-2010</td>
<td>145.52</td>
<td>118.93</td>
<td>26.60</td>
</tr>
<tr>
<td>2010-2011</td>
<td>147.54</td>
<td>127.62</td>
<td>19.73</td>
</tr>
<tr>
<td>2011-2012</td>
<td>184.21</td>
<td>147.30</td>
<td>36.90</td>
</tr>
<tr>
<td>2012-2013</td>
<td>219.69</td>
<td>193.79</td>
<td>25.90</td>
</tr>
<tr>
<td>2013-2014</td>
<td>248.03</td>
<td>209.49</td>
<td>38.54</td>
</tr>
<tr>
<td>2014-2015</td>
<td>235.47</td>
<td>193.20</td>
<td>42.27</td>
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<td>2015-2016</td>
<td>240.13</td>
<td>213.13</td>
<td>27.00</td>
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</tbody>
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6. CONCLUSIONS WITH SALIENT FEATURES

6.1 Financial Cost Recovery

- The pre-paid smart card system ensures 100% collection from farmers and by being totally transparent eliminates rent seeking and corruption. It is also fair with farmers paying according to volume of water they use.
- The use of electric power for pumping greatly reduces pumping costs due to the Government’s subsidy. In most areas covered by the BMDA load shedding is not a major problem.
- Farmers themselves provide an informal back up of water supplies by pumping from ponds and khals.
- The BMDA pre-paid smart card system requires electric powered pumps and power supply for the meters.
- With a buried pipe distribution system the pump runs for 10-20 seconds after a farmer’s user card is withdrawn (the amount being charged to the card). Another card needs to be inserted within this time of the pump shuts down. Once a pump stops it cannot be restarted for 3-5 minutes to avoid damage to the motor.
BMDA undertakes a number of cost recovery/income generation activities which help support the financing of the authority as well as provide direct and indirect benefit to farmers.

6.2 Water Use Efficiency

- While the pre-paid card system can work with open channels operational losses are significant as the canal prism empties / fills when water is rotated to different outlets. A buried pipe system remains full. Pipeline diameters used vary from 6-10 inch (160 – 250 mm).
- Farmer irrigation service is good with a direct link between volume supplied and cost. It is claimed that water use efficiency has greatly improved as farmers minimize their costs.

Scheme Size

- The full pumped flow (typ. 28-56 l/s) is used by one farmer who may split the flow so that field crop damage is avoided.

Cropping

- With the prepaid user card and buried pipe system farmers irrigate a variety of crops, including tomato, and boro – paddy lock in is avoided.

Backup power

- Despite frequent power cuts the Barind does not provide any back up power supply. Farmers individually or collectively provide some back up supply from ponds and Khals (drains)

7. CONCLUDING REMARK

In conclusion, the author was asked by IWMI representative in an interview during India Water Week on 8-12 April, 2013 and published in the IWMI’s under the title “Boom in Barind: a model for India’s irrigators to follow” is being enclosed as Appendix A. Based on the field experience in Barind for more than 20 years author strongly believes that the Chief Executive of successful irrigation project should have a clear idea about water, soil and people.

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THE POTENTIAL ROLES OF FARMERS’ ORGANIZATIONS AND PRIVATE SERVICE PROVIDERS IN IMPROVING THE LIVELIHOOD OF FARMERS IN THE MUDA AREA, MALAYSIA

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ABSTRACT

The Muda Irrigation Scheme is managed by Muda Agricultural Development Authority (MADA) is located in the North-west of Peninsula Malaysia is the largest granary area in Malaysia with an area of 100,685 hectares from the total of 677,900 hectares rice cultivation area in Malaysia. MADA accounts for approximately 40% of the country’s rice production with total production exceeding 1 million tonnes per year. The annual income of the farmers has increased from RM3,523 in 1970s to RM30,530 in recent year. The extension services are conducted by irrigation blocks concept involving agricultural and irrigation extension officers and was introduced in 2015 to ensure effective delivery system of MADA to further enhance farmers' understanding of rice crop management at farm level. There are 172 irrigation blocks in the scheme which is managed by 27 Farmers’ Organizations (FOs) of four MADA administrative regions. Under the set-up of the FO the elected Chairman and the appointed irrigation bureau member are responsible for the irrigation scheduling and other related water management of the FO’s locality. They are also responsible to coordinate the activities related to the water management at Small Agriculture Unit (SAU) or village levels. The planning of main extension activities in these irrigation blocks is coordinated by Rice Industry Division and Water Management Services Division of MADA.

Implementation of extension by irrigation blocks at FOs level is conducted by re-assigning the task of agricultural and irrigation extension staff by extension zones whereby each zone consists of several irrigation blocks instead of SAU. Prior to this exercise the extension irrigation service is based on irrigation block while the agriculture extension is based on SAU. Extension services within the zone will cover all parties involved in the rice industry such as farmers, service providers for machineries and community leaders.

Introduction of agriculture machineries for land preparation in late 1960s and combine harvesters in 1975 by private sector has changed rice cultivation scenario in the Muda area. Involvement of services providers such as tractor operators, combine harvester operators and rice millers are also important in ensuring the success of rice double cropping in the scheme. Capacity and machines availability of each service provider is fully considered prior to the decision of setting up the 3 phases of planting schedule and determination of harvesting period as well as rice production of the seasons. There are about 4,117 registered tractor operators and 700 combine harvester operators in the scheme. Regular meetings at pre-planting and mid-seasons are held with all the stakeholders to discuss and forecast the situation of the crop and harvesting pattern.

To further enhance the water management efficiency at FOs localities MADA has initiated the water users’ groups (WUG) among farmers in the scheme. Until 2018 there were 54 WUGs which are actively involved in the water management at localities or farm levels. The committee which consist of local farmers in the irrigation blocks have successfully transformed the way of water management from top down to empowered style of management.

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Keywords: extension services, irrigation block, service providers, water user groups

1. INTRODUCTION

The Muda Irrigation Area which is managed by the Muda Agricultural Development Authority (MADA) covers about 130,282 hectares of which 100,685 hectares are rice fields. This rice area covers two states namely Kedah (82,968 hectares) and Perlis (17,717 hectares). The area of rice planting represents 35.13% of the country’s granary area, the largest in Malaysia and is called The Rice Bowl of Malaysia. MADA operates 3 dams, which is the Muda, Pedu and Ahning Dam. The two dams Muda and Pedu are the main source of water for irrigation to enable rice double cropping in the area. Good management from these dam are important to ensure that water release from the dam is consistent to enable rice double cropping to be carried out and to fulfill needs of the country.

MADA was established on 30 June 1970 to operate and maintain the Muda Irrigation Scheme, a major rural development project launched under the First Malaysian Plan at a cost of RM238 million consisting of 172 irrigation blocks. MADA is also responsible for planning and implementing agricultural development programs and upgrade the livelihood of 55,130 farmers in the Muda area. MADA's organizational structure has been designed to incorporate the roles of three key departments directly related to the implementation of Muda Irrigation Scheme namely Department of Irrigation and Drainage (DID), Department of Agriculture (DOA), and Farmers Organization Authority (FOA). As stipulated in Act 70 MUDA Agricultural Development Authority Act, the integral role of MADA is to develop and encourage the economic and social development in the Muda area and to plan any form of activities as indicated by the authorities in Kedah and Perlis. Besides that, the specific tasks of MADA are:

i. To provide agriculture service for rice production and irrigation infrastructure to ensure rice production in the Muda area can fulfill the nation’s need.

ii. To ensure the water source is managed effective and efficiently.

iii. To increase the income of farmers through the agricultural activities, and to develop agro-based industry as well as to nurture commercial entrepreneurs.

iv. To establish farmers institution, and to exert efforts in achieving economic and social development among the farmers community.

The achievement of MADA since its establishment in 1970 includes an increase in rice production. In the 1966-1970 era (single cropping) the average gross yield was 3.2 tonnes/hectare per year. This yield has increased to 4.2 tonnes/hectare in 1976-1980 (31.25% increase) and above 5 tonnes/hectare (56.25% increase) commencing from year 2000 except in 2006 due to flood involving an area of 18, 246 hectare (18%) of the total area. For the first time, the yield of rice in the Muda area reached 6.31 tonnes/hectare in Season 1/2012. The average yield of Muda Area from 1966 to 2017 (Figure 1).

2. INCOME OF FARMERS

Before MADA was established in 1970, the annual net income of farmers was merely RM1,092, and have significantly elevated to RM9,220 per year in 1993. During the 21st century, the total average income of farmer was recorded at RM16,644.00 per year. The income level of farmers has continuously increased in which in 2009, it is reported that the average farmers income has increased to RM27,471 per year. Specifically, the agriculture income was RM25,574. while RM1,897 was the income from the non-agrobased activities. In 2017, the net income has augmented to RM30,121. This has reduced the poverty level in the Muda area from 72% in 1966 to only 1% of the population living under poverty in 2018.
2.1 Stakeholders

Generally in Malaysia, rice cultivation involves eight (8) major players who play their respective roles, namely farmers, service providers, agrochemical companies, rice millers, wholesalers, retailers, consumers and governments. The service providers may consist of farmers, Board members of Farmers Organization (FO) and also non-farmers.

![Figure 1: Average Yield (tonnes/hectare) in The Muda Area (1966-2017)]

Source: MADA Statistical Book, 2017

Farmers are players in the primary stage of rice production. In the context of MADA there are 55,130 farmers who are directly involved in rice planting activities. Since the establishment of MADA, the farmers are always given special attention by the government through various assistance and incentives including subsidies.

Service providers of farm mechanization for land preparation and harvesting stage play an important role in the development of rice industry in the Muda Area. While most of the agrochemical companies who supply agriculture inputs also play vital role for the industry. For examples, there are several companies which provides pesticide spraying and fertilizer application using agricultural drones that can speed up work process and be safer for operators.

In addition, the involvement of agrochemical companies in rice industry also helps in terms of increasing the potential yield of the farmers.In Malaysia, agrochemical companies are also involved in the supply of subsidized agricultural inputs besides open market sales.

Whilst the rice millers, wholesalers and retailers are secondary players while users are players at tertiary level. The government through Ministry of Agriculture and Agro Based Industry (MOA), acts as a catalyst for the rice sector through the department or agency under it with the drafting and implementing of relevant policies, assistance/incentives, enforcement, development and research, finance and other relevant aspects for the welfare of all players in the rice sector.
3. FARMERS’ ORGANIZATIONS IN THE MUDA AREA

There are 27 Farmers’ Organizations (FOs) in the Muda area. Each FO is led by a line up of Board of Directors (BOD) elected through votes in the General Meeting. The vision of FO in the Muda area is to become the driver in transforming the socio-economic development of the farmers. And the mission is to improve the FO as a competitive farmer’s entity that is able to provide efficient and effective services to farmers in the Muda area.

There are ten (10) bureaus in the FOs that carry out specific task, among others are:

i. Bureau of Administration, Finance and Investment  
ii. Bureau of Irrigation  
iii. Bureau of Machineries  
iv. Bureau of Agribusiness  
v. Bureau of Credit  
vi. Bureau of Extension, Training and Development  
vii. Bureau of Welfare and Religion  
viii. Bureau of Contract and Special Project  
ix. Bureau of Young and Women Farmer  
x. Bureau of Paddy Estate Management

Each bureau will be led by the appointed farmer’s representative and is responsible for each of the specified portfolio. Often the irrigation bureau will work with the mechanization bureau to ensure smooth planting activity. As of 2016, the number of membership of FOs is 50,441 compared to 49,761 in 2015. This increase in the number of membership indicates the confidence of farmers in the Muda Area towards the strength of FOs.

There are four (4) major roles of FOs in the Muda area, among them are:

- Center of extension services, such as agricultural and irrigation advisory.  
- Distribution center for government’s aid and incentive.  
- Implementation of economic activities to improve local farmers lives.  
- Implementation of social and community activities.

4. PRIVATE SERVICE PROVIDERS IN THE MUDA AREA

Despite the various efforts undertaken, the role of MADA is usually limited to the level of rice production only which involves providing of irrigation and drainage infrastructure facilities, water management and extension services, while land preparation and harvesting activities are provided by the private sector. Currently, there are about 4,117 registered tractor operators and 700 combine harvester operators in the Muda area.

To create economic competition and providing the best service, MADA has allowed service providers such as tractors, harvesters and transportation operators to participate in rice industry in the Muda Area. The development of machineries is evolved according to demand and supply. The private service providers also contribute to the success of development of rice industry in the Muda Area through better planting schedule adherence which leads to better and uniform, rice crop management.

The service provider network system has been inherited traditionally before the establishment of MADA, and the practice continues today. Mastery of service provider in an area has created a zoning situation according to the service provider. This situation illustrates that each service provider will serve in each zone and guarantees equality in the distribution of income sources for all providers.
Rice will be sold by the farmers either individually or in the rice collection centers which is owned by FOs or private sectors in their respective areas. Transportation of paddy to mills is done by service providers and most farmers rely entirely on them in marketing activities. These service providers also sometimes offer credit loans in cash and additional agricultural inputs to farmers. Most farmers do not have transportation such as lorries so they choose the service provider or FOs to market their harvest. This situation has created significant dependence on service providers as intermediaries (middle man) between farmers and producers.

Roles of Farmers’ Organizations and Private Service Providers

Through this essence, MADA through its FOs has expanded its role not only in rice production but also the overall value chain of the rice sector in the Muda area. The chart of implementation of the upstream and downstream activities in the Muda area, in particular the role played by the service providers and rice millers is shown in Figures 2 and 3.

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**Figure 2:** Linkages of FO and private service providers’ activities at farm level

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**Figure 3:** Linkages of FO and private service providers’ activities at marketing level

In the Muda Area, all of the FOs revenue is mainly depend on rice related activities. These include projects namely the rice estate, government’s inputs distribution, machineries and sales of agriculture inputs.
Since 2011, all FOs in the Muda Area are involved in the development of rice estate project, where management of participating farms is centralized and fully managed by the FOs. This estate management concept is introduced to solve the issues of uneconomic farm size and aging farmers. And the main target of the project is to increase productivity. Currently there are 38,358 hectares of estate managed by the FOs with 20,299 farmers involved.

The success of the project depends on good collaboration among stakeholders. For machineries such as tractors and combine harvesters, the function of FOs are to coordinate the arrangement between farmers and service providers.

In general, farmers used to contact service providers through the middle man in order to fix dates for land preparation and harvesting, then they would set up proper service charges. However, in individual negotiation, large scale machines are not utilized efficiently because the area involved is too small for operation. The cost of the whole transaction including arranging the date and fixing the service charge may also be increased under individual negotiation. In addition, dates fixed through individual negotiations are often inconvenient to service providers to keep to. In the end, differences between farmers expected plans and the real operation have created serious managerial problems for the farmers themselves.

Since the project is centrally managed by the FOs, the planting schedule is easier to adhere to. Service providers only need to discuss with the FOs’ management to determine operation schedule at farm level resulting in a better planting schedule adherence.

There are cases where FOs successfully negotiated with the service providers, hereby receiving up to 10% rebate of the contract service charges to put towards a fund to be used for farmer activities. In other case, FOs managed to reduce the cost of production and increased land productivity by proper adjustment of farm operations by synchronizing the planting time. Negotiation for farm activities such as land preparation and harvesting involving larger areas allow for lower service charges offerings by the service providers. Thus increasing the income of the farmers is achieved by lowering the operation costs. The negotiation for rice marketing process was also made by the FOs with the rice millers to create a win-win situation where the FOs were able to sell high quality rice in bulk while ensuring a good grading rates, and at the same time assisting the rice millers to meet their rice purchasing quota.

Through FOs management as well as cooperation from service providers, estates in the Muda area has achieved higher yield, ranging from 5 tonnes per hectare in 1990s to 6 tonnes per hectare after the rice estate established in 2011. Judging from the progressive cases mentioned above, it seems that a high and stable yield can be attained through more rational management of the small-sized farmers. MADA also benefited from adherence of the planting schedules while service providers have guaranteed with operating area and payments. And most importantly, farmers earn a better income.

5. ESTABLISHMENT OF WATER USER GROUPS (WUG)

FOs in the Muda Area also actively involved in ensuring good water management practices at farm level. Establishment of Water User Group (WUG) is one of the action taken by the FOs. WUG in the Muda Area was established based on the consolidation of the Small Agricultural Units (SAUs) to implement one irrigation management at the irrigation block level. There are four (4) main thrust of WUG which is to:

1. Encourage participation of Agricultural Driven Project (PPP) in a contiguous area through the formation of WUG.
2. Increase efficiency in water allocation and distribution among farmers in the irrigation blocks.
3. Implement “in-house” planting schedule in irrigation blocks.
4. Increase water and land productivity (kg/m³ – kg/ha)

The WUG Committee is a committee based on voluntary service consist of the WUG secretariat who will be working closely with the Chairman of the Irrigation Bureau. The WUG secretariat comprises of MADA staff from the FOs’ irrigation unit and also the appointed farmer who leads the water management, agronomy and mechanization committee in the WUG. The staff of MADA who are members of the secretariat will guide and monitor farmers in the WUG to operate and maintain the irrigation system in the blocks to comply with the MADA’s requirement. And the farmers in WUG committee will mutually implement among farmers the irrigation activities and maintenance in the blocks with the main target to increase yield and also planting schedule adherence.

With WUG establishment in the Muda Area, the farmers are very much involved in the process of planning the tertiary irrigation development such as tertiary canals and drains. Besides that, the farmers are also willing to volunteer to take over the minor maintenance of the irrigation infrastructure. This helps reduce government spending and also creating a sense of belonging among farmers towards the irrigation infrastructure in their respective area.

Until 2018, there are 54 groups has been established with a total area of 37,607.02 hectares of rice cultivation area and is expected to continue growing in numbers.

6. CONCLUSION

In general, the service provider’s role cannot be ignored. Good cooperation between farmers and service providers is needed in the Muda area to ensure that the rice planting schedule can be complied with, adherence to good agricultural practices and the farmers get the best prices for the services provided. The role of MADA through its FOs and the establishment of WUGs greatly helps to empower the livelihood of farmers in the Muda area. In short, adherence to the planting schedule can help in good management of rice cultivation as well as the management of pests and diseases. This can help increase yields while guaranteeing more income to the farmers, and also the service provider.

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ACHEVING SUSTAINABILITY IN AN IRRIGATION SCHEME:
LESSONS LEARNED BY CAVAC’s CAMBODIAN PROGRAM

Daravy Khiev¹ and Sreymom Sam²

ABSTRACT

The management of sustainable irrigation systems has long been a challenge in Cambodia, where rice crop farming predominates: in taking on irrigation management, Farmer Water User Communities (FWUCs) have faced many problems. Indeed, the sustainable operation and maintenance (O&M) of irrigation systems involves a number of factors that will be illustrated in this paper, drawn from lessons learned in implementing the Cambodia Agricultural Value Chain (CAVAC) program.

The goal of the program is to achieve irrigation systems that are well managed, with operations and maintenance functions that are effective and efficient. In order to achieve this, the program has, over time, evolved to change its approach: i) improving its design quality by modernising and developing its systems so that they are now equipped with lined canals and with highly efficient pumps that are simple to operate; ii) consulting with farmers and relevant stakeholders from the very start of the scheme assessment, through the design, construction and post-construction phases, taking their suggestions and comments into consideration, and incorporating changes or compromises as appropriate; and iii) supporting community development by improving the irrigation system infrastructures to meet farmers’ needs and by providing on-the-job training in management skills, including financial management, conflict resolution, and O&M planning and implementation. The elements of this approach have coalesced to build trust among farmers and have been drawn from the lessons learned by the program in its quest to achieve sustainability for its irrigation schemes.

Keywords: Irrigation, sustainable irrigation, Cambodia, Farmer Water User Community (FWUC), Water User Association (WUA).

1. INTRODUCTION

Reports from the Ministry of Agriculture, Forestry and Fisheries (e.g. 2017) show that around 80 percent of Cambodia’s population live in rural areas, and around 44 percent of the total population are directly engaged in the agriculture sector. Agricultural household income is generated from agriculture produce, mainly rice. Cambodia’s long history of agricultural production, and the associated irrigation issues, dates back to the Angkorian period, which ran from the 9th to the late 14th century, and persists to this day. For most of that time, irrigation management and development in Cambodia could be described as positive, but the Khmer Rouge period, when much damage was done to all aspects of the country, put a stop to this, affecting not only physical infrastructure, but also the mentality of Cambodian society as a whole.

The ensuing lack of support and resources has had a major negative impact on the whole country. The limited financial resources available from the government have resulted in the insufficient development of irrigation infrastructure, which, for its subsequent management, depends heavily on farmers. It is, therefore, important to provide as much support as possible to a community once an irrigation scheme has

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been established so that its members have the skills and understanding to operate it in a sustainable manner.

The Cambodia Agricultural Value Chain (CAVAC) program is an Australian-funded initiative that has been focusing on agriculture and irrigation development in Cambodia since 2010, and will continue until end of 2021. The focus of the program’s irrigation component involves not only the construction of the irrigation infrastructure, but also the development of the Farmer Water User Communities (FWUCs), also commonly known as Water User Associations (WUA)³, who are needed to ensure the sustainability of the scheme once it is up and running. The CAVAC program incorporates flexibility in its implementation, acknowledging that success requires the full engagement of the farming community throughout the whole process.

2. BACKGROUND

Irrigation plays a vital role in the livelihoods of Cambodian farmers. This means that they have traditionally either depended on the unreliability of rainfall, or have faced the high costs involved in using inefficient portable mobile pumps. CAVAC’s intervention has, therefore, responded to this challenge, aiming to improve and stabilise farmers’ livelihoods through investing in irrigation infrastructure and in supporting the establishment of communities that are equipped to ensure the sustainability of these systems.

In so doing, CAVAC’s focus has been on delivering improved rural infrastructure through irrigation schemes that overcome the weaknesses of their predecessors. The aim was to avoid the failed O&M systems that had tended to undermine large irrigation investments. Through the application of a “fully developed system” model for sustainable irrigation, CAVAC has worked to ensure that scheme designs meet farmers’ needs and, consequently, give them the incentive to adopt and take responsibility for O&M systems that have a greater potential for long-term sustainability.

Initially, the CAVAC program faced many challenges for three main reasons. First, the conventional approaches to irrigation development, based on insufficient consultation with farmers, had often resulted in poor quality, incomplete designs leading to schemes that functioned poorly. Inadequate structures meant that farmers could not access water on time, while inefficient portable mobile pumps kept pumping costs high. Second, insufficient consultation with farmers and other stake holders also meant that particular interests were not identified and consequently no compromises were made to ensure that everyone’s needs were met. Third, after the FWUC establishment, there was insufficient support for integrating improvements to the scheme or for developing the FWUC’s capacity to manage the scheme. These factors made farmers reluctant to pay the Irrigation Service Fees (ISFs), and this hampered scheme sustainability.

This paper is based entirely on empirical experiences from 2010 to the present day in the implementation of the CAVAC program, of which Irrigation and Water Management (IWM) is a major component. It will illustrate how, throughout the program, the changes in technical design, and approaches to community development, which evolved along the way, have played a crucial role in the currently successful, sustainable management of the program’s irrigation schemes.

3. CAVAC’S APPROACH

The principles underlying CAVAC program implementation thus allow for a “trial and error” process, enabling improvements in the scheme development and management by the community to be identified and incorporated. The learning curve that has

³ This term will be used interchangeably with FWUC in this paper.
resulted from this flexibility, and “trial and error” approach has facilitated a gradual adjustment in CAVAC’s approach over the last nine years. It is exemplified by: i) improvements in design and construction; ii) an emphasis on consultations and coordination with farmers and other stakeholders; and iii) a heavy focus on facilitating and building the capacity of FWUCs.

3.1. Irrigation Scheme Design

CAVAC’s experience has underlined the fact that an initially high investment in a system will lower the ensuing maintenance costs. This is particularly relevant in the context of Cambodia, where government budgets available to cover maintenance costs are limited.

At the beginning of the CAVAC program, the aim was to keep irrigation investment low. But this resulted in high pumping and maintenance costs that became a heavy burden for farmers. Realising this, the program changed, investing more highly at the initial design stage so that each “fully developed” system could be equipped with an efficient electrical pump (>70%) serving the whole command area, thereby lowering costs for farmers. This change in the initial design concept has increased the efficiency in the operation and maintenance of the schemes through an initial higher investment in a more modern system.

Similarly, CAVAC saw the value of providing “complete” scheme systems. “Complete” refers to fully-developed schemes that have main canals, secondary canals, drainage, and all necessary structures. The modernisation of a scheme relates to the lining of canals that are constructed in different models - i.e., concrete, parabolic, or brick canals – in order to ensure efficiency, a reduced need for land contribution and low maintenance costs. This has been a further influence.

Lessons learned from other projects suggested that many pumping stations were inefficient and difficult to operate. So, CAVAC pump houses now include high efficiency central electrical pumps to serve water to the whole command area, keeping pumping cost low. A simple button operation avoids confusion for operators.

3.2. Underlining Project Ownership Through Participation

In 1995 (30), Chambers argued that the success of a project depends on an understanding of the difference between “we participate in their project” and “they participate in our project”. In the context of this paper, “we” refers to project implementers, while “they” refers to users/farmers. Expanding Chamber’s argument, CAVAC’s experience is that the success of a project depends on the power given to end-users, encouraging them to take ownership from the very start of the project. It means that the “implementers” play the role of facilitators, ensuring the active participation in the project of the “users/farmers” so that, at the completion of the project, acceptance of the ownership of the scheme management is a natural outcome. The sooner the empowerment of the users to take ownership of the project starts, the more entrenched this mind-set becomes.

CAVAC’s current approach, therefore, ensures that participation takes place throughout the irrigation scheme development. Before construction, many consultations are held with farmers, on the one hand enabling them to fully express all of their requirements, and on the other for the implementers to explain what the farmers can expect during the construction stage and what their anticipated roles will be after the construction has been completed. Also, through constant participation, all stakeholders are taken into account, and this includes farmers, local authorities, technical departments (the Provincial Department of Water Resources and Meteorology - PDWRAM) and, where relevant, private sector representatives.
Farmers’ Participation

If farmers’ trust is to be nurtured, their needs must be appropriately addressed: and they need to be assured that their requests are taken seriously into account. This does not mean that a request always receives a “yes”, but it does mean that a “no” answer is accompanied by a full explanation of the reasons for refusal. A speedy response also enables the farmers to work on other solutions, or to find compromises before it is too late. If their requests do not receive a response, they may well be unwilling to participate in the future.

Being transparent with farmers throughout requires all technical design options to be presented to them with a full explanation of all of the pros and cons, and then allowing them to choose the one that they can agree on. Although consultations are conducted all along the way from the beginning of the program, farmers cannot necessarily visualise all possible outcomes, so flexibility must be built into the process.

Participation of Other Relevant Stakeholders

Communication not just among farmers, but also encompassing FWUC committee members and all other relevant stakeholders in irrigation management is a further vital element of success. Without a common understanding among all of the players, the goal of scheme effectiveness, efficiency and sustainability will be difficult to achieve. Therefore, to perform their vital roles, representatives from the local authorities and PDWRAMs need to be constantly involved - from the beginning and throughout the development process.

Indeed, the PDWRAMs are particularly important partners in providing long-term support for FWUCs, in promoting transparency and in facilitating regular, effective communication. They have profound knowledge of local conditions, and have recognised, legitimate power to give advice to the FWUC, from its initial establishment onwards.

An early lesson learned by CAVAC was in failing to fully appreciate the importance of PDWRAMs as team members in implementing irrigation schemes: while PDWRAMs’ technical engineering skills might not have been high, their understanding of local contexts made them invaluable colleagues. Building a strong relationship with them has thus become one of the first priorities of any CAVAC scheme. If they are involved
from the start, they know the history and all of the complications that have been addressed and overcome. And the support of PDWRAM staff becomes even more important after the scheme is handed over to the community. FWUCs have to address the needs of their users in a responsive way as possible and sometimes responding to requests is beyond their capacity; in such circumstances, consultations with PDWRAM staff will often provide a way forward.

A further potentially complicating factor is the social and political context: failing to acknowledge and address this may well hinder project sustainability. The local authorities can be particularly helpful here. They are familiar with the context and are used to interacting in often sensitive circumstances and situations. Thus, their inputs are important in facilitating the whole process right from the start. They, too, need to be kept well informed, and their advice is crucial in helping to guide the project design and implementation. Overall, the focus on participation will ensure that the interests and concerns of all parties are heard, constructive comments are elicited, and that inputs in general benefit not only the program but also the community as a whole.

3.3. On-going and Effective Support

A particularly important lesson learned by CAVAC was that it takes time for a Water User Association to be fully operational – this will not happen until at least two years after the irrigation scheme construction has been completed. The precise time it takes may vary from scheme to scheme, but for however long it takes, it is essential to provide the necessary support.

Indeed, it has been noted that a failure to provide such continuing support is the reason why many programs in Cambodia have fallen by the wayside. And there is currently little government support available to plug the gap after a scheme has been completed and the project personnel have withdrawn. Recognising this challenge, CAVAC has developed a focus on, first, continuing to improve a scheme’s physical infrastructure even after initial construction has been completed. At the same time, it has also acknowledged that developing hard and soft skills through on-the-job-training for the FWUC committee members is a long-term task if they are to be given the capacity to manage the scheme in a sustainable manner. Vital skills include not just financial management, but also conflict resolution, leadership, scheme operation and management, and so on. CAVAC staff, particularly the O&M specialists and the engineers, thus continue to work with the FWUC for at least two years after scheme construction has finished.

The development among community end-users of a different mentality or mind-set also requires support. Farmers often become confused when they are confronted by a new system that is very different from what they have been used to. Furthermore, they are accustomed to behaving in an individualistic way, i.e., their behavioural norm is to compete for water because its supply has traditionally been unstable and uncertain. In contrast, the new system guarantees a reliable water source, although a little patience might be required.

Farmers need to learn to trust that the irrigation system and the FWUC will deliver. They are also likely to be somewhat bewildered, not only about how the committee should operate, but also about how they should interact with it. They are likely to be confused about the need for certain new rules and by-laws – and how these will affect them. Their practices will have changed from a self-centred focus – whereby the individual farmers have seen themselves in competition with their neighbours - to collective action whereby farmers must act together to ensure their water supply. In turn, this less “individualistic” mentality supports the development of information-sharing in respect of the cropping calendar and water allocation schedule. The gradual development and acknowledgement of such information-sharing processes can also form an important element of ongoing community development.
Scheme improvements

The operation of an irrigation scheme can be complex, requiring engineers who are appropriately qualified and able to give effective guidance to users. A limited construction timeframe, with often less than a year available for the design phase, means that schemes may not be fully operational in the first season. Sometimes additional drainage canals are required for the system to work well. In other cases, more structures are needed to ensure effective water allocation. CAVAC has recognised this as an integral phase of its program implementation, ensuring that ongoing technical and financial support is available to make these improvements.

Even after this initial improvement phase, other problems can emerge and also require adjustment: it is understood that a reliable water source is essential to provide service to the users in a timely and sufficient manner. But, as long as water is delivered to the field at the right time and in the right quantity, farmers are willing to pay the ISFs.

Community Management

Support for the FWUCs plays an important role in the sustainability of the whole irrigation scheme, and Irrigation Service Fee (ISF) collection is far from the only aspect in this process: appropriate management of that money is the next vital component. Transparent and effective financial management, in which FWUC committees are trained by CAVAC after the completion of the scheme construction, is vital. CAVAC has noted that, at first, newly-elected FWUC committees do not fully understand what the ISF is for, or why its correct management is important. Social norms that currently prevail in Cambodian society mean that farmers are not used to transparent systems, and their generally low level of education endows them with little understanding of the importance of money management and of long-term financial planning.

Giving FWUC members the associated training is, therefore, key to the success of the irrigation scheme, enabling the FWUC to understand that financial management does not only relate to the day-to-day fee collection, but also embraces the whole system of financial planning and reporting. FWUC members need, for instance, to understand the importance of planning ahead, putting enough money aside for O&M plans to ensure that the irrigation system can be managed sustainably over the long term. They also need guidance to ensure that financial systems are transparent, that they are openly accountable to their members, and can, therefore, be trusted. Without this trust, farmers will be less willing to pay their ISFs and the FWUC can quickly become dysfunctional. Well-kept records, transparent accounting procedures, and a determination to exemplify accountability by holding regular meetings with farmers, sharing important information about, for instance, plans for the next cropping season and water allocation, and by being responsive to their requests, are essential for trust-building.

Again, CAVAC provides long-term, on-the-job-training for FWUCs. The CAVAC program has also evolved to create a system that encourages farmers to pay their ISFs by providing receipts with accurate information, and a transparent charging system. This contrasts with many schemes in Cambodia that do not deliver invoices in this way. In addition, the CAVAC program has been implementing a mobile payment billing system through which farmers can pay their ISFs to agents in their own area or elsewhere in the country. The system has gained the trust of farmers through its transparency. It is also valued by the FWUCs – they do not face the risk of transporting large sums of money to the bank - and the process saves them a lot of time in that they no longer have to remain in the office for whole days and weekends to perform the time-consuming tasks of receiving payments, administering them and then depositing them in the bank.
The implementation of effective community management in respect of the operation and maintenance of the scheme is another hurdle that many Cambodian FWUCs have not yet cleared, and this is largely due to insufficient funds: the government does not have the money to rehabilitate or maintain all irrigation infrastructure in the country. According to Cambodian legislation this is a shared responsibility between the Royal Government of Cambodia (the Ministry of Water Resources and Meteorology and its provincial departments) and the FWUCs. O&M budgets are increasing but are still far from sufficient. In response, CAVAC has set up systems for O&M that do not require too much external support and these are a further important contribution to the ability of the FWUC to manage its irrigation schemes sustainably. It also helps to build the confidence of farmers in their scheme and the trust they have in the ability of their FWUC to undertake its management.

The CAVAC program thus stays with the FWUCs fora minimum of two years, helping them to develop maintenance plans and budgets. At a later stage, the CAVAC program also works with them to conduct clear and transparent procurement processes, to prepare contracts, and to monitor their work. Gradually, FWUC performance starts to improve. Activities become habitual. The FWUC committee knows when and what they are expected to do as managers of the scheme. They are open to new challenges and respond positively to comments from their customers (farmers). Farmers start to realize that the system belongs to them, and what is consequently expected of them as users. They know what they are entitled to as "clients". Both the FWUC and the farmers act as suppliers and clients. In CAVAC’s experience few FWUCs have yet reached this stage. That said, there is every reason to believe that, with sufficient support, this goal could be commonly achievable.

In short, the CAVAC process has developed to focus on a learning-by-doing approach for all participants, during which FWUCs are gradually guided to assume more and more responsibility until they are competent to take on the full, independent and sustainable management of their scheme.

4. CONCLUSION

Achieving the most appropriate results requires a good conceptual scheme design that has been developed after a great deal of participation, communication and compromise between the engineers and the end-users, and that subsequently provides the desired level of support for the community after its establishment.

The schemes developed by CAVAC focus on making an appropriate response to the struggle farmers have faced in accessing reliable and affordable water. This approach has, in turn, generated a high level of trust among farmers and has reduced the burden they faced in terms of maintenance costs.

Where many projects have facilitated only minimal communication between the design engineers and end users, CAVAC’s program has been designed to build bridges between these people. An emphasis on flexibility has enabled schemes to evolve to meet actual needs. Farmers have also been encouraged to develop a sense of ownership of the scheme because they have been consulted about it from day one. Once the scheme is fully and appropriately operational – and can ensure sufficient water access for its end-users– the willingness of farmers to participate means that they not only use and look after their scheme, but are also willing to pay the irrigation service fee because they are satisfied with the service they receive.

Once the FWUC has been established, and its members trained, the CAVAC program continues to support them. Training in the O&M of the scheme generally takes place on-the-job. Furthermore, given that it is unlikely that the initial design of a scheme will be entirely optimal, improvements are generally implemented to address this as a matter of course: for instance, additional structures might be built, or drainage canals installed. Assured of a reliable water supply, with a properly trained FWUC managing the financial aspects and scheme operation in a transparent and
innovative way, farmers are consequently willing to pay the associated fee. The conditions necessary for scheme sustainability are, therefore, in place.

5. REFERENCES


IRRIGATION MANAGEMENT TRANSFER IN THE PHILIPPINES

Joop Stoutjesdijk

ABSTRACT

The Philippines has been one of the frontrunners with Participatory Irrigation Management (PIM) and Irrigation Management Transfer (IMT). Irrigators’ Associations (IA) have been established in the Philippines since the seventies, but their roles and responsibilities were not always very clear. The World Bank has supported the National Irrigation Administration (NIA) in the Philippines with a model whereby transfer took place gradually over a longer period. As part of the Bank-funded Participatory Irrigation Development Project (PIDP), IAs and NIA would sign a model agreement, starting with model 1. The agreement clearly explained the responsibilities of IAs and NIA and the percentage of Irrigation Service Fee (ISF) to be received by the IAs. Model 1 left most of the management, operation, and maintenance (MOM) with NIA, while IAs would support NIA with this. As IAs matured through training and support provided by NIA and gaining experience, a model 2 would be agreed and signed. Over time, model 4 would be entered in with the full MOM of a scheme the responsibility of IAs. The paper explains the evolution of and experiences with the models, the adaptation of NIA to changing conditions, the support and training provided by NIA to IAs, as well some of the constraints experienced, including reluctance by some NIA offices to allow IAs to move to a higher model as that would impact the financial sustainability of the NIA office. The impact of the abolishment of the irrigation service fees in 2017 and the response by IAs is discussed. Finally, the impact of mature IAs on improved scheme management and production is explained.

1. IRRIGATION DEVELOPMENTS OVER THE YEARS

Public sector investment in irrigation began after the establishment of the National Irrigation Administration (NIA) in 1963. NIA is a government owned and controlled corporation which is responsible for the construction, rehabilitation and management of national irrigation systems (NIS). The main aim of the irrigation investments has been for the Philippines to become self-sufficient in rice production. Over the years public capital investments in irrigation have fluctuated significantly, with the peak periods during the seventies, coinciding with the green revolution, and again during the past few years to reduce the ever increasing rice imports.

At the end of 2015, the total irrigated agricultural land was estimated at 1.73 million hectares (ha) or about 57.3 percent of the 3.02 million ha total irrigable land in the Philippines (Philippines Statistics Authority 2016). The two main irrigation systems are NIS and communal irrigation systems (CIS). NIS, covering about 766,000 ha, are government-owned irrigation systems built to provide water for agricultural purposes to farmers for a fee. CIS, covering about 586,000 ha, are irrigation systems that are often constructed with support from government, but are owned by farmers through a farmers cooperative or community association.
2. THE ROLE OF IRRIGATORS ASSOCIATIONS

Since the 1970s, NIA has been one of the frontrunners with irrigation management transfer (IMT). The objective was to transfer the responsibility of operation and maintenance of part of the or entire irrigation systems to irrigators associations and also contribute funds through an irrigation service fee (ISF).

NIA used an innovative way of calculating ISF, using a certain weight of rice and the prevailing rice support price. The ISF per ha is calculated as follows: X kg * rice support price. X is 150 kg and 100 kg during the dry and wet season, respectively. In 2017, the rice support price was PhP17/kg. The ISF was thus PhP2,550 (US$49.50) and PhP1,700 (US$33.00) per ha during the 2017 dry and wet season, respectively. The fee collection has typically been around 60 percent. As not uncommon with a blend price, this ISF was sufficient for some schemes, while other schemes would have required more funds and would have also benefitted from higher collection rates. Main reasons for the relatively low collection rate was the absence of a penalty system that could have cut off water to farmers that did not contribute and the poor condition of the infrastructure in many schemes that negatively impacted the delivery of water to the tail end of the systems.

There were issues with the IMT leading to mixed results. Issues included unwillingness and lack of preparedness among the farmers to takeover management responsibilities, lack of clear cut IMT policies, and poor condition of irrigation infrastructure (Mukherji 2009). The participation of IAs in irrigation systems’ O&M had mixed results. Strong IAs were able to comply with their systems’ O&M responsibilities, while newly organized and/or weak IAs only had limited O&M participation. All these factors adversely affected NIA’s revenues and reduced its capability to adequately cover O&M. NIA and IAs were unable to efficiently sustain irrigation services in many NIS (most of which were old and in operation for over 30 years) due to lack of sufficient funds to maintain them. This led to further deterioration of the NIS during the first decade after the turn of the century, decrease in irrigated area, and reduction in cropping intensity which affected the IA members’ willingness to pay ISF.

3. THE PARTICIPATORY IRRIGATION DEVELOPMENT PROJECT

The World Bank-funded Participatory Irrigation Development Project (PIDP) that was implemented from 2009 to 2018 was designed to address the above-mentioned structural and institutional issues, in response to government’s strategy to prioritize investments for the rehabilitation and improvement of existing NIS and the promotion of IMT through capacity building of IAs for effective O&M of NIS (World Bank 2009). PIDP specifically supported the organizational development and technical capacity building for IAs, strengthened the capacity of NIA staff to support the IAs and manage their work more effectively, and implemented IMT model contracts for O&M and ISF collection as contribution to finance O&M. The project supported 904 IAs in project-assisted NIS that signed IMT model contract agreements. Training courses focused on organizational development and strengthening, leadership and skills enhancement, O&M and management of NIS, and financial management. Training outputs included the development of the IA’s cropping calendar, water distribution plan, system O&M plan, and budgeting and financial recording system. After observing the success of the institutional support under PIDP, NIA rolled out the IA capacity building activities under the IMT Program to some 2,100 IAs outside of the project NIS.

Overall IA training and support was provided by NIA’s institutional Development Division in NIA’s Central Office in Manila. Each of the 14 Regional Offices (RO) also has a dedicated unit that provides IA training and support. The NIA office that is closest to the farmers and IAs is the Irrigation Management Office (IMO). Each RO has a
number of IMOs that each manage one or a few irrigation schemes. IMOs also have dedicated staff that works closely with the IAs, providing continuous support and regular training.

4. THE IRRIGATION MODELS

The strategy for the management transfer of an NIS includes four different IMT model contracts (models 1 to 4) reflecting the increasing level of responsibility of IAs in the operation and maintenance of their NIS:

- **Model 1** - NIA manages the entire NIS, but transfers specific operation and maintenance activities to the IA such as: (i) maintenance of lower-order canals; (ii) operation activities such as discharge monitoring, preparation of a list of irrigated and planted area, and distribution of water among turnouts; and (iii) distribution of ISF bills and campaign for payment;

- **Model 2** - NIA manages the main system, from the headworks to the main canal up to the head gates of lateral canals and transfers to the IA the management of the laterals, sub-laterals, and terminal facilities;

- **Model 3** - NIA manages the headworks and portion of the main canal up to the junction of the first lateral canal and transfers to the IA the management of the rest of the system downstream of the specified junction; and

- **Model 4** - NIA completely transfers to the IA the management of the entire system including the headworks and stops all its activities on directly managing the system except on monitoring and evaluating the IA performance, collecting seasonal or annual payments from the IA, and periodic technical assistance to the IA by its Irrigation Management Office that has jurisdiction over the system.

IAs would be compensated for performing the management functions transferred by the NIA to the IA. For Model 1, the compensation of the IA consisted of two parts: one for canal maintenance and the other for assisting in specific operation activities. Payment of the compensation of the IA for canal maintenance was supposed to be paid by NIA within thirty (30) days from NIA’s receipt of the claim for payment from the IA. For Models 2 and 3 in gravity systems, the share of the NIA from current account collections would vary, based on negotiations between NIA and the IA, and would be stipulated in the IMT contract.

For Model 1, NIA would monitor and evaluate the IA activities particularly on its compliance with the provisions of the IMT contract, provide on-the-job training to the IA on the specific O&M functions transferred to IAs, and assist the IA in the resolution of water-related conflicts among IAs, turnout service area groups (TSAG) or farmers. For Models 2 to 4, NIA’s responsibility would shift from performing the usual O&M activities on their own within the service area to providing the on-the-job training to the IA on O&M functions transferred to them and managing and resolving water-related problems that were beyond the capacity of the IAs to resolve. The areas where the IA typically needed strengthening included planning the O&M, budgeting and fund management, O&M plan implementation, monitoring and evaluation, and other organizational management essential in the compliance of the IA on its contract obligations.

The IAs were given the prerogative to decide the level of the IMT model contract based on their capacity and readiness to assume O&M responsibilities. This was very important as they were not forced to assume responsibilities that were not yet matched with their skills and experience. Most IAs opted to start with Model 1, and would
gradually move to a higher model whenever the IA members would feel comfortable with such a move, based on the training and other support received from NIA. At the end of 2016, 904 IAs in the PIDP-supported NIS had model contracts, with many either model 2 or 3 (Figure 1).

At times there was reluctance by some NIA offices to allow IAs to move to a higher model. IMOs are fully dependent on ISF for the payment of salaries to staff and the upkeep of the office. As transition to a higher model provides the IAs with more O&M funds, the amount of funds received by IMOs would reduce. This would not only reduce the importance of the IMO, but would also lead to having insufficient funds for the IMO’s operation.

The Government in 2016 instituted a major policy change when it abolished the ISF and declared irrigation delivery service free under the Free Irrigation Service Law (Republic Act 10969). This law changed the nature of irrigation service delivery in the country from being a semi-commercial operation into a purely government-subsidized public service. To compensate for the loss of ISF, a major source of NIA’s revenue, the Government provided O&M subsidy to NIA starting in 2017 at a level similar to the average annual ISF collected during 2014 - 2016. This meant that the funding required by NIA and the IAs for O&M activities remained stable before and after the abolishing of the ISF.

After the abolishing of ISF, almost all IAs signed a modified IMT contract that stipulated the subsidy to be received by an IA. Signing of such contract was a prerequisite for receiving the subsidy that had two elements, a fix rate of PhP400 (US$7.75) per ha under irrigation in a particular season and PhP1,750 (US$34.00) for regularly maintaining 7 km of concrete lined canal or 3.5 km of earthen canal. For many IAs, especially the ones with the higher models, these subsidies were insufficient. However, the training and other technical support provided to IAs had provided awareness among their members that adequate funds should be available for proper and timely conduct of O&M. Contrary to the situation in other countries that do not have ISF, many IAs in the Philippines started collecting contributions (referred to under different names such as sustainability fund, O&M assistance fund, voluntary contributions for O&M, etc.) from their members to augment their resources for O&M and organizational development activities. The contributions were agreed through the IA General Assembly. This showed that the comprehensive institutional development support provided under PIDP has led to mature IAs that were fully aware of the O&M requirements and their corresponding responsibilities.
5. IMPACT OF PROJECT INTERVENTIONS

Certain outcome indicators were used to assess the mechanisms by which improved irrigation service delivery could be sustained beyond the project. The assumption was that rehabilitation of irrigation and drainage infrastructure coupled with IAs' increased role in O&M activities would help sustain irrigation service delivery. Some of the main achievements are described in the next paragraphs.

As part of the IMT contracting arrangement, the IAs were given a share from the ISF collection, with the percentage depending on the model contract. A total of 71% of the 904 IAs received their share from the ISF collection within one month after collection as stipulated in the model contract (World Bank 2019). This was a significant improvement considering that, before PIDP and the support provided to NIA and IAs, only about 10% of the IAs were able to receive their ISF shares on time. The quick release of their ISF shares enabled the IAs to undertake regular O&M activities on schedule.

NIA conducts an annual Farmers’ Satisfaction Survey, which is a nationwide survey undertaken by a third-party survey team. The survey determines the IA members’ satisfaction on the following: (a) compliance in the implementation of agreed cropping calendar; (b) timeliness in the delivery and distribution of irrigation water; (c) equitability in the delivery and distribution of irrigation water; (d) NIA action on the requested rehabilitation and construction of irrigation systems and projects; (e) quality of construction and rehabilitation of irrigation facilities and structures; (f) action on the requests for technical advisories/support services; (g) quality of technical advisories/support services provided; (h) prompt action on request for trainings and other capacity building programs; and (i) quality of training and other capacity building programs provided. As a result of the project’s technical and institutional development interventions, 97% of the 904 project IAs reported a satisfactory rating for irrigation services received, especially on the timely delivery of water, NIA’s technical support in maintaining main infrastructure, and assistance to IAs in O&M activities.

Cropping intensity in the project NIS increased from 150 (of 72,000 ha) to 171 percent (of 125,000 ha). The average paddy rice yield in the project-covered NIS increased from the baseline of 4.27 tons/ha and 4.48 tons/ha during the wet and dry seasons in 2009, respectively to 5.00 tons/ha and 5.26 tons/ha or about 17 percent higher, during the wet and dry seasons in 2017, respectively. The increased yield was due to IA/farmer institutional strengthening and technology transfer, including better water governance, adoption of water savings technology, and improved availability of water gave many farmers confidence to use high quality hybrid seeds.

6. CONCLUSIONS AND LESSONS LEARNED

The main conclusions and lessons learned from PIDP include:

(a) Irrigation management transfer supported by a comprehensive training program to IAs results in better system management, but transition needs to be carefully scheduled, which was done through the Model system;

(b) The proper sequencing of activities for IA strengthening is important to support IAs through a progressive capacity development process, not only at the leadership level, but all the way down to irrigation services turn-out groups to build understanding and commitment to effective O&M across all members;
(c) It is important to have qualified IA support staff at scheme level in the Irrigation Management Office (IMO);

(d) IMT has to go hand-in-hand with physical system improvement, to be designed with full participation of IAs; and

(e) Although the abolishing of ISF collection was a set-back for many IAs, mature IAs were able to convince their members to find alternative ways to collect sufficient funds for O&M.

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IRRIGATION SERVICE AGREEMENTS – AN INSTRUMENT IN MODERNIZATION OF IRRIGATION MANAGEMENT IN INDONESIA

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ABSTRACT

The World Bank financed Strategic Irrigation Modernization and Urgent Rehabilitation Project (SIMURP), is part of the ongoing National Reform Agenda that focuses on decentralization, democratization, and modernization of irrigation management and is based on the principles of participatory irrigation management. Where under previous programs attention has been paid only to the decentralized provincial and district irrigation systems, SIMURP is now focusing on the larger national irrigation schemes. The project aims to improve delivery of irrigation and drainage services and strengthen transparency and accountability in selected national irrigation schemes through modernization of irrigation management, and rehabilitation and upgrading of irrigation and drainage infrastructure and management facilities. Improvement of irrigation service provision, transparency and accountability will include the introduction of irrigation service agreements and improvement of the asset management systems. The Irrigation Service Agreements (ISA) will be introduced in the SIMURP’s 14 National Irrigation System sand in the Jatiluhur system that is managed by PJT2, a state-owned enterprise. This paper presents the background and the activities carried out in the SIMURP to date and the challenges faced in the introduction of irrigation service agreements in Indonesia.

1. IRRIGATION MANAGEMENT REFORM AND MODERNIZATION IN INDONESIA

After a period of intensive engagement in rehabilitation of irrigation systems in the 70ies and 80ies, and the piloting and field testing of participatory irrigation approaches in the 90ies, the World Bank provided support to Indonesia's irrigation sector reform as part of the democratization and decentralization policies since the beginning of this century. The support focused on the scaling up of participatory approaches through a broad and coherent program that emphasized the establishment and development at national and local level of water resources and irrigation management institutions like self-governing Water User Associations (WUA) and their Federations (WUAFs), the establishment and strengthening of River Basin Organizations (Balai Wilayah Sungai)and Irrigation Management Agencies, and coordination platforms like the Irrigation Commissions (Komir), and Water Resources Management Committees to foster coordination. The program included support for the development of policy, legal, regulatory, and administrative frameworks at national and local level for the introduction of participatory management practices. The reform process was scaled up under the Water Resources and Irrigation Sector Management Program (WISMP 1 & 2) that started after the promulgation of a new Law7/2004 on Water Resources and associated Government and Ministerial Regulations on Irrigation. WISMP 1 & 2 focused on participative irrigation management, urgent rehabilitation, and increased role of WUAs/WUAFs in operation and maintenance of provincial and district irrigation systems and was a joint effort of the Ministries of Public Works and Housing, Home Affairs and Agriculture.

The currently World Bank financed Strategic Irrigation Modernization and Urgent Rehabilitation Project (SIMURP), is part of this ongoing National Reform Agenda that focuses on decentralization, democratization, and modernization of irrigation management and is based on the principles of participatory irrigation management. Moreover, SIMURP is addressing the need for adaptation of irrigation management to a rapidly changing management environment i.e. the transformation of the socio-

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economic, climatic and environmental situation in which irrigation services are to be delivered. Where under previous programs attention has been paid only to the decentralized provincial and district irrigation systems, SIMURP is now focusing on the larger national irrigation schemes.

2. THE CHANGING IRRIGATION MANAGEMENT ENVIRONMENT

The economy and consequently the management environment of irrigated agriculture in Indonesia is changing rapidly and it affects the management of irrigation systems and the provision of irrigation and drainage services. Pressure on land and water resources has increased and will continue to do so due to population growth, urbanization, diversification of economic activities, increased climate variability, pollution and catchment degradation. The agriculture sector is subject to important changes as well as demand for crops is becoming more diversified not only because of changing diets and more affluent spending patterns, but also due to increasing demand for industrial crops, feed and fodder. Farmers are required to produce more crops of better quality in a larger time window on less land with less water of lesser quality. Food production systems and thus the enabling irrigation service delivery need to be adjusted, not only following increasingly demanding markets in terms of diversity, timing, quality and safety, but also respond to concerns on environmental impacts, water use efficiency and sustainability of the overall production systems.

Production systems also need to be adjusted following the rapidly changing land tenure situation to cope with the changing value of land and the transformation of land use. Food security and rice self-sufficiency are policy priorities of the Government of Indonesia.

However, present rice production systems are economically and financially not very rewarding in smallholder farm systems. To meet livelihood standards, farmers increasingly need and do find off-farm revenue generating opportunities necessitating change in agriculture and irrigation practice. Consequently, land tenure moves drastically to land lease or share cropping arrangements where landownership is mostly in the hand of smaller and larger urban investors and speculators. Sustainable and viable farming needs to be scaled up from a marginal subsistence practice to a commercially viable agricultural enterprise creating opportunity for higher levels of mechanization. All these external pressures require not only a more flexible and responsive and cost-effective delivery of irrigation services, but also a new look at irrigation and drainage infrastructure.

The technology available for managing irrigation systems has drastically changed with the introduction of modern information and communication technology and control systems making more flexible and responsive service provision possible and affordable. The management paradigm for irrigation service delivery is changing from a supply driven centralistic approach to a participatory demand-oriented approach introducing new actors and new rules. The traditional labor-intensive irrigation management systems are no longer affordable seen the number of personnel needed and the rise in labor costs. Moreover, the function of the irrigation canals is becoming more diverse and other more important uses and users of irrigation systems increasingly depend on reliable provision of their services. This requires a new view on application of information, communication and flow control technology in conjunction with human resources management and outsourcing of selected O&M activities.

SIMURP aims to improve delivery of irrigation and drainage services and strengthen transparency and accountability in selected national irrigation schemes through modernization of irrigation management, and rehabilitation and upgrading of irrigation and drainage management facilities and infrastructure. Improvement of reliability and responsiveness of irrigation service provision, and increasing transparency and accountability will include the introduction of irrigation service agreements and the
associated improvement of the asset management systems. The Irrigation Service Agreements (ISA) will be introduced in the SIMURP’s 14 National Irrigation Systems with a total of 100,000 hain nine river basin organizations (RBO)s as part of these efforts, and in the 240,000 ha Jatiluhur system that is partly managed by PJT2, a state-owned enterprise.

3. ORGANIZATION OF IRRIGATION AND DRAINAGE SERVICE DELIVERY IN NATIONAL SYSTEMS

National irrigation systems are those systems with a service area larger than 3,000 hectares, are crossing provincial boundaries or are of strategic importance. The management of the systems is based on the principle of one system, one management. The River Basin Organization or B(B)WS have the single management authority in National Irrigation Systems and is the owner of the irrigation and drainage assets. The management is fully funded from National Budget (APBN).

The development, rehabilitation and modernization of the assets is the task of the RBO (BBWS). But, although it is their responsibility, they generally have no capacity to implement the day to day O&M of the irrigation and drainage systems. The task for direct service delivery and maintenance of the assets is instead delegated to provincial and district irrigation services through a system of task assistance (i.e. Tugas Pembantuan or TP-OP). The Central Government agency requests Local Government (province or district) to assist in the implementation of their task to be funded by the national budget. The purpose of this TP-OP system is to ensure the implementation of the day to day operation and routine and periodic maintenance, to overcome the limitations in capacity, staff and outreach of central government apparatus through the involvement of the local government apparatus. Consequently, with the introduction of the TP-OP there are many more actors on National, Provincial and District level involved in the implementation of irrigation and drainage service delivery: The Ministry, the RBOs (BBWS), the Provincial and Kabupaten Agencies), the Irrigation Commissions and the Water User Associations.

The division of tasks and responsibilities is regulated in a Ministerial Regulation on TP-OP. However, this regulation is focusing on the relationship between the Ministry and the Provincial Government as the recipient of TP-OP. The relationship between the Province and Kabupaten agencies on TP-OP seems not to be regulated adequately and depends on regular collaboration agreements. The complex multi-tier responsibility for irrigation service provision in National Systems requires explicit Service Agreements between the different tiers (National – Provincial and Kabupaten Services) and between the service provider and the water users.

4. PLANNING OF TP-OP

Asset Management: The management of assets is regulated in guidelines (Pedoman PAI). Asset inventories have been prepared to serve as a basis for the annual survey that is made by the provincial and Kabupaten Irrigation Service of the condition and functionality of the irrigation (and should be drainage and service/access roads) structures and canals and the conditions of facilities and human resources. The surveys and reporting follow prescribed criteria using standard forms. RBO (BBWS) is to update these registers every 5 years though special surveys.

Performance Index: These annual surveys are translated in the performance index of the irrigation systems (Index Kinerja Sistem Irrigasi - IKSI) and an estimate of the real irrigation management cost (AKNPI) which includes the estimate of the real

3 The Jatiluhur system (240,000 hectares) is an exception as it is managed by PJT2, by a State-Owned Enterprise (SOE). The management is supposed to be funded through the SOE revenues though irrigation services may not be charged.
irrigation O&M cost (AKNOP – Angka Kebutuhan Nyata Operasi dan Pemeliharaan). Based on the AKNOP in various provinces, budget ceilings are set by the Directorate of Guidance for O&M (DPOP). In consultation with the system users, priorities for operation staff and routine and periodic maintenance and rehabilitation are set and a program is made. This proposal is forwarded to the BBWS for approval/endorsement. Once approved, the TP-OP funds are sent to the provincial irrigation service as APBN budget item for them to administer and implement.

**Funding O&M TP-OP.** The funding of O&M for national irrigation systems consists of allocations to the RBOs (BBWS) and the TP-OP to the Province. The total annual allocations vary around 1 trillion Rupiah or some 430 thousand Rupiah per hectare. The total allocation for TPOP covers the operation and the routine and periodic maintenance of the national irrigation systems and on average amount 70% of the total O&M allocation from the Ministry. As said above, the O&M of weirs, and larger repair works or rehabilitation on irrigation and drainage systems are not included in the TP-OP but in the separate O&M budgets of the RBOs (BWS).

**Table 1.** Total O&M Budget and TPOP allocations for National Irrigation Systems (BBWS + SKPD Province - TPOP) (Source: DGWR-DOM)

<table>
<thead>
<tr>
<th>Year</th>
<th>National Irrigation Service Area</th>
<th>Total O&amp;M Allocation</th>
<th>TPOP Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>2,393,910</td>
<td>2,004,877</td>
<td>1,024,041</td>
</tr>
<tr>
<td>2015</td>
<td>2,251,918</td>
<td>2,054,440</td>
<td>910,736</td>
</tr>
<tr>
<td>2016</td>
<td>2,385,860</td>
<td>2,070,566</td>
<td>1,209,398</td>
</tr>
<tr>
<td>2017</td>
<td>2,359,615</td>
<td>2,067,911</td>
<td>1,042,240</td>
</tr>
</tbody>
</table>

The allocations to the provincial irrigation services are based on the assessment of the real O&M cost needs that is prepared annually by the Kabupaten and Provincial Agencies based on surveys and system walkthrough. The actual allocations vary considerably from the AKNOP in the range from 35-73% for selected provinces (Table 2).

**Table 2.** Required (AKNOP) versus Real Allocations for 2018 in Selected Provinces

<table>
<thead>
<tr>
<th>Province</th>
<th>Number of TP-OP Systems</th>
<th>Area TP-OP [ha]</th>
<th>AKNOP</th>
<th>Actual Allocation</th>
<th>Actual allocation as percentage of AKNOP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Billion Rp</td>
<td>Thousand Rp/ha</td>
<td>Billion Rp</td>
</tr>
<tr>
<td>West Java</td>
<td>17</td>
<td>399,963</td>
<td>178</td>
<td>445</td>
<td>103</td>
</tr>
<tr>
<td>Central Java</td>
<td>31</td>
<td>300,125</td>
<td>270</td>
<td>900</td>
<td>95</td>
</tr>
<tr>
<td>D.I. Yogyakarta</td>
<td>2</td>
<td>12,000</td>
<td>4.8</td>
<td>400</td>
<td>3.45</td>
</tr>
<tr>
<td>East Java</td>
<td>32</td>
<td>298,641</td>
<td>259</td>
<td>900</td>
<td>91</td>
</tr>
</tbody>
</table>

The funds for TP-OP are used for Operation (O), Routine Maintenance (RM), Periodic Maintenance (PM) and others like AKNOP surveys and budget preparation. The guidance provided by DPOP is to allocate budget evenly between O, RM and PM. However, seen the shortfall in budget, some provincial services give priority to meeting operation requirements first, i.e. get the necessary field-staff in place hence causing deference of maintenance of the infrastructure.

4 The TPOP area following PERMEN PUPR No 14/2015 needs to be revised as much conversion of irrigated land has taken place, especially after the construction of the Trans Java toll road.
5. MODERNIZATION OF MANAGEMENT OF NATIONAL IRRIGATION SYSTEMS

The Strategic Irrigation Modernization and Urgent Rehabilitation Program (SIMURP) aims to increase agricultural production and productivity in support of the national food security and rice self-sufficiency agenda through the provision of services that are responsive to the needs of water users. The project focus is on management modernization and consequent rehabilitation and modernization of infrastructure of national irrigation systems with a total service area of around 350,000 hectares.

The Government has prepared an approach and an action plan to irrigation management modernization with the aim to support enhancement of food security and farmer's prosperity by improving levels of service, enhancing efficiency, effectiveness and sustainability of management whilst adjusting to changing environmental, social, economic and agronomic conditions and new government policies. The approach comprises the introduction of participatory irrigation management (PPSIP) in National irrigation systems following the WISMP 1 and 2 projects under local government systems and adjusted in pilots under WISMP-2. The project is based on this Government's five-pillar irrigation modernization framework:

(i) Enhancing water availability for water security;
(ii) Enhancing irrigation and drainage infrastructure to ensure the delivery of the agreed level of service;
(iii) Modernizing the management system to enhance service delivery and management performance
(iv) Adjustment of Irrigation Management Institutions to ensure responsive, cost effective accountable and reliable and service delivery;
(v) Development of Human Resources to meet the appropriate number competencies and skills

Essential elements in the process towards an accountable and transparent provision of irrigation services are the introduction and explicit incorporation into the management system of water use rights, water accounting, water allocation and distribution rules, asset management, monitoring systems, and complaint/conflict handling mechanisms. Institutions with responsibilities for river basin, and irrigation management include the national, provincial and district river basin and irrigation agencies, the water users’ associations and their federations, and the irrigation commissions. For them to become more capable, accountable and responsive a service orientation will be developed through the development of client services, service standards, and service agreements, in parallel with the development of informed and empowered stakeholder platforms for interaction and negotiations between the various stakeholders like the irrigation commission (KOMIR) and Basin Commission (TKPSDA). Transparent budgeting and financing mechanisms will be developed on the basis of multi-year asset management plans. All these elements will be encapsulated in irrigation service agreements (ISA).These agreements will not only be between the irrigation system manager and the water user associations or their federation (WUAF) but also between different other tiers in the management system i.e. between basin manager, bulk water manager and irrigation system manager.

5.1 Irrigation Service Agreements

An Irrigation Service Agreement (ISA) is a system specific agreement between an irrigation service provider and the irrigation water users and possible other service recipients who regulate the transactions, eligibility, and conditions associated with irrigation and drainage services (Figure 1). The ISA is an instrument that helps to provide clarity in the relation between the irrigation service provider and the water
users. To establish clarity on responsibilities, rights and obligations of service provider and water users, the ISA will need to describe:

(i) the kind and location of services to be delivered for the benefit of users;
(ii) the conditions and eligibility for service delivery;
(iii) the rights and obligations of the users (clients) and service providers;
(iv) the procedures for service delivery;
(v) the method of verification of meeting obligations and the consequences of not meeting these;
(vi) the conflict resolution mechanism; and
(vii) the process to modify the agreement.

Figure 1 Service Agreement

The development process of an irrigation service agreement under SIMURP is done in three main stages:

A. **Assessment** of current conditions and management practices

B. **Consultative Process** on reaching an agreement on the services to be provided, the contribution in service delivery by the beneficiaries; the conditions, procedures and verification for service delivery and

C. **Development of the institutional and physical infrastructure** needed to provide the services agreed.

The development of ISA starts with an assessment of the actual management situation in the selected systems and comprises:

(i) the governance structure of the irrigation management system,
(ii) the relevant policies affecting irrigation management i.e. water use rights, irrigation and agriculture policies and practices, and the climatological and hydrological conditions,
(iii) the current system of delivery of irrigation services: how it is defined, how it is organized and implemented,
(iv) the institutional and legal framework in which services are provided, and
(v) the physical condition of the irrigation and drainage infrastructure.
Figure 2. Framework for Service Agreement Development (Malano, van Hofwegen, 2006)

After these assessments have been made, the process will follow 10 steps:

(i) definition of, and agreement on the nature of the services;
(ii) identification of the stakeholders i.e. the service providers and their clients;
(iii) definition of service linkages and service interfaces;
(iv) verification of institutional and legal framework, and infrastructure;
(v) establishment of platform for dialogue ISA formulation;
(vi) preparation of service scenarios: i.e. service levels, procedures, cost;
(vii) preparation of accountability mechanism scenarios;
(viii) preparation of draft ISA;
(ix) formulation of program when needed, for possible necessary modifications in the legal, institutional and physical framework linked to the 5 pillars for modernization for operators as well as farmers;
(x) decision and signing of ISA and AM.

Important qualities of the definition of the level of service are: that it must emerge from an extensive consultation process; that it becomes a set of norms and targets against which operational performance is measured; that it must be revised on an ongoing basis to respond to changes in irrigated agriculture; and that it is given careful consideration of the cost associated with the provision of specific levels of service.

6. IRRIGATION SERVICE AGREEMENT DEVELOPMENT ISSUES

6.1 The Nature of the Services

Irrigation serves the enhancement of agriculture production and generally the improvement of farm productivity to enhance farm incomes. The activities related to this do not limit themselves to irrigation but also drainage, flood protection, road infrastructure and information to and guidance of farmers in the optimization of agriculture practice and water use. The basic nature of the irrigation service is usually consisting of but not limited to:

(i) The provision of irrigation water supply;
(ii) The removal of excess water through the drainage systems;
(iii) The provision of physical and non-physical flood risk mitigation measures;
(iv) The provision of access to farm units through a (farm) road network; and
(v) The guidance to the WUA/P3A on organization of the WUAs and agriculture water management.

In many national irrigation systems, the focus is on the development of infrastructure and the main on water supply when service provision in the O&M stage comes in. Often the drainage and access road infrastructure has been developed but these are generally of lower priority in the exercising of O&M and of general service provision.

**Figure 1.** Domain for Irrigation, Drainage and Flood Protection Services (RBO=River Basin Organization)

### 6.2 The Irrigation Service Providers

The management of the national irrigation systems is the responsibility of the Directorate General of Water Resources (DGWR) of the Ministry of Public Works and Housing (MoPH) through their RBOs (BBWS). The RBOs (BBWS) having the official authority, would in principle be the service provider. However, as the RBOs (BBWS) do not have the field staff and are quite distant from farmers and farmer organizations, it was decided to request provincial governments to carry out the O&M of the irrigation systems with financial support from central government ton their behalf through TP-OP. However, also the provinces lack the field staff so they on their turn rely on the District irrigation management agencies to carry out the O&M for them.

The O&M of national irrigation systems is thus carried out by provincial and district agencies and funded by DGWR through TP-OP. The question now arises who could be considered to be the actual service provider being fully responsible for the quality of service delivery. Prior to start the debate of the service linkages, clarity needs to be obtained about the role sharing and accountability mechanisms in the O&M of the irrigation and drainage systems.

### 6.2.1 The Services Recipients

The ultimate beneficiaries of the irrigation services are the individual farmers/water users. Acknowledging the vast number of farmers and farm units, and the capability and desire of farmers to handle the lowest level of water distribution among themselves the tradition to deliver water to a group of farmers or villages was established in legislation and will remain for the foreseeable time. The question arose whether the official recipients of the irrigation services should be the tertiary unit managed by a WUA or a block of tertiary units managed by a WUAF. After a workshop with the ISA team it was concluded that the recipient of the irrigation...
service will be the WUA that is responsible for the management of the tertiary units. However, not in all systems do the WUA coincide with the tertiary unit borders. For example, in East Java the WUA (or HIPPA) are organized following village boundaries so it may well happen that in such situation more WUAs govern one tertiary unit.

In many of the irrigation systems under SIMURP WUA are already established, however, many of them seem not to have a legal status. Such status is necessary for the WUA to enter into a service agreement and to act as a partner of the service provider for contracted or financially supported implementation O&M activities by the WUA in the (main) irrigation system. The situation of the legal status of the WUA in the participating systems needs to be assessed and when necessary, the WUAs need to be established strengthen and legalized prior to their engagement in an ISA as foreseen in SIMURP.

It is likely that in the national irrigation systems also other users are supplied with water e.g. local water supply companies or local industries. In such cases, special arrangements between the WUA and irrigation service provider may be necessary to meet the different kind of service that is required by these different users, i.e. continuity in supply, water quality standards or certain reliable intermittent supply. They may well be member of the WUA or WUAF and be part of an ISA between the WUA/F and the irrigation agency, or they may be an independent client with a separate ISA.

6.2.2 Service Linkages and Service Interfaces

The management of irrigation is done through a tiered system with hierarchy of different institutions. The first tier is the River Basin. The allocation and delivery of water to the irrigation system is the responsibility of the RBOs (BBWS) in case of National River basins, or the BPSDA in case of provincial basins. The allocation is coordinated through the “Technical Basin Committee” or TKPSDA. The intake at the river headworks is the point of delivery to the irrigation system manager or the service interface between the river basin organization and the irrigation management organization.

The second tier is the Irrigation Main system in which water allocation and distribution is the responsibility of the irrigation service (see below). Here water is delivered to WUA through the tertiary turnout i.e. the service interface between the irrigation service and the WUA. In large irrigation systems intermediate tiers sometimes exits for example where the main system operation is separated from the secondary systems like in the Jatiluhur irrigation system. Coordination at this level is done by the Irrigation Commission.

The third tier of management is within the tertiary units and is the responsibility of the water users. The water users’ associations are coordinated by their federation that also is represented in the irrigation commission.

6.2.3 Adequacy of funding

The TP-OP allocations are considerably less than the needs indicated through AKNOP. The question now is whether you can engage in a service agreement when there is no certainty about the financial resources available for service delivery. Seen the structure of AKNOP there are two options that can be considered in combination: (i) increase in budget or (ii) reduce needs. Can there be gains made through modernization in the factors and activities that determine the need? (e.g. data, facilities, etc.). Or can there be a higher level of participation of the WUA/WUAF/WUAI through delegation of some O&M tasks to them? This requires further assessment and can be regulated in the ISA.
The allocations are for the O&M tasks mentioned above. All other expenditures related to the permanent staff salaries, facilities and equipment (assets) are to be borne by the Province or Kabupaten Agencies of which allocations need to be decided by the local parliament (DPRD). The question arises to what extent does local government feel responsible and is committed to allocate local funds for O&M of national assets.

The first line of service provision is in most cases the Kabupaten irrigation service, but they often do rely on Kabupaten budget to do those essential activities that are not covered or readily available by TP-OP. Is there a need to broaden the scope of TP-OP financing or is there a need to regulate local government responsibilities in National Irrigation systems to ensure budget allocation?

6.2.4 Monitoring and Evaluation – Reporting

Monitoring and Evaluation of TP-OP is described in the guideline that has been issued by the Sub-directorate of O&M Irrigation and Swamps in October 2017. The aim of the M&E is to be informed about the organization (SKPD) that implements the TPOP, the status of TPOP implementation (type of contracts, or force account), physical and financial progress and the inventory of problems faced and their anticipated solutions.

The monitoring of TP-OP is oriented towards meeting the bureaucratic and administrative requirements associated with the regulations and less so with the provision of adequate and reliable irrigation and drainage services. The monitoring forms are looking at output indicators, not at the quality of outputs. To evaluate the success of TP-OP, also outcome and impact indicators need to be monitored. The outcome indicator for TP-OP should be on the adequacy, equity, reliability and efficiency of water delivery. The impact indicator could relate to the productivity in terms of value per hectare or value per volume of water supplied. In a service-oriented management of the irrigation and drainage systems, the outcome indicators concern the quality of service delivery and will need to be monitored as part of the ISA.

6.2.5 Human Resources Management

TP-OP implementation very much depends on the irrigation management capacity of the Kabupaten agencies. The strength of these agencies depends on the one hand on the area that is managed under Kabupaten authority (< 1000 ha) as this provides reason and opportunity for the local government to allocate resources for staffing and facilities. However, Some Kabupaten even do not have any irrigation systems smaller...
than 1000 ha (e.g. Demak-Central Java) so the whole Kabupaten irrigation agency is to serve the National (or provincial) irrigation systems. If the Kabupaten area is small compared to the irrigation areas that are to be managed through TP-OP, several problems rise.

The first problem is the lack of field staff. The Kabupaten structure maintains the traditional organization structure of Pengamat (system supervisor covering some 5000 hectares), JuruPengairan (Canal supervisor covering some 500-1000 ha), gate keepers (PPA) and laborers. For a considerable length of time the government policy is not to recruit new civil servants. Consequently, many permanent civil servant irrigation agency staff members have not been replaced after retirement by new civil servants, but by contract labor. The contract workers are the PPA and laborers and in the National systems they are generally paid for out of the TP-OP budget. Their contracts are usually on an annual basis so every year a serious effort has to be made to bring up all new recruits up to the desired standard of knowledge and skill. The Pengamats and Jurus are in general civil servants. When retired they are very difficult to replace because of their very specific knowledge of the system and the water users and skills on how to deal and interact with their clients. Their costs are generally covered from the Kabupaten budget. It is difficult for the Kabupaten administration to recruit new civil servants that are not working in the Kabupaten domain. Hence many Juru areas have merged resulting in less Jurus managing bigger areas and more farmers and villages. This trend is not sustainable and structural changes need to be made.

Another issue is the status of contract PPA and laborers. It is well known that by engaging persons though contracts to implement government tasks, expectations are raised to become civil servants in the longer run. This leads to many disappointments. One solution found in the UPTD Serayu-Bogowonto was to engage the PPA through the WUAF/WUAI. The WUAF/WUAI is engaged though a contract with the UPTD to recruit PPA. The PPA will however be paid directly by the Provincial Service.

The HR Policies of most Kabupatens is oriented towards meeting staffing needs for achievement of Kabupaten policies and targets. Hence the replacement of Kabupaten staff to meet national targets will be of lesser priority. What options are available within the TP-OP structure to meet adequate staffing in terms of quantity and quality, i.e. reduction of staffing needs through modernization of management; maintenance contracts; management contracts (maybe with WUAF/WUAI)?

7. CONCLUSIONS

There are many issues related to the implementation of TP-OP that need to be clarified or resolved to create a sustainable irrigation service delivery practice. A combination of financial, institutional and physical interventions may help to bring sustainability of reliable service delivery to a higher level. The development of a synchronized effort to modernize irrigation management, modernize or upgrade irrigation infrastructure and facilities combined with the introduction of Irrigation Service Agreements and better financial arrangements between the various tiers of management and service provision will be an important contribution to achieving this goal. SIMURP intends to work on all these aspects in the selected national irrigation systems.

8. REFERENCES

PARTICIPATORY IRRIGATION IN MAHARASHTRA- HISTORY, APPROACH AND SUCCESS STORIES

Er. Rajendra Pawar¹

ABSTRACT

The Maharashtra is the largest state in India covering area 30.8 million ha. and is second most populated state having population 112.37 million. As we know the usable water in the state is limited, and from water available for irrigation maximum 85 lakh ha land can be irrigated by flow irrigation method that means it is just 37.37% of total culturable area in the state.

Participatory management has assumed great importance in Maharashtra in the last few decades due to the growing difficulties faced in water resource management. There is an increasing crisis in water resource management in Maharashtra and this is becoming very serious as development accelerates. Scarcity of water has become a common problem in Maharashtra and quality of water is also getting affected due to industrialization.

The management of water distribution across the vast area of state, amongst the millions of farmers/users, in equitable manner, is becoming a major challenge. The government of Maharashtra took corrective step on this issue by introducing Maharashtra Management of Irrigation System by Farmers ACT 2005 (MMISF act). Maharashtra is the first state in India who has enacted acts like Maharashtra Management of Irrigation System by Farmers ACT 2005 and Maharashtra Water Resources Regulatory Authority Act 2005.

The State of Maharashtra has a quite old historical background in PIM, few examples are:

- Phad system in northern Maharashtra
- Ex Malgujari tank in eastern Vidharbha,
- Khajana Bawadi in Beed district
- Pani panchayat & canal committee in Bombay region

Maharashtra State is pioneer in PIM. There are successful examples of Water User Associations (WUA) in various parts of the state. With this background, Maharashtra Government has made it mandatory to the irrigation beneficiaries to form Water User Association to empower the users and provide justice to tail-enders and weaker section of society.

Government has encouraged the farmers to form water Users’ Association for distribution of water to them on volumetric basis. For implementation of Participatory Irrigation Management following steps are initiated:

- Formation of WUA’s under Co-operative Act-1960
- Formation of State water policy - 2003, for equitable and optimum water utilization
- Maharashtra Water Resources Regulatory Authority 2005 Act Enactment

¹ The Author is working as Secretary (Command Area Development), Water Resources Department, Government of Maharashtra, India. He is working in the field of Water Management for last 35 years.
• Maharashtra Management of Irrigation System by Farmers 2005 Act Enactment

Now it is mandatory to form water user association under Maharashtra Management of Irrigation System by Farmers 2005 Act only as per the latest GR issued by WRD Maharashtra dated 06/04/2016.

1. MALGUZARI TANKS

Malguzari tanks were ponds made for water harvesting by the Malguzaars (revenue collectors), who were zamindars or tenants in eastern Vidarbha, Maharashtra two centuries ago. These tanks provided water for irrigation and also increased the availability of fish for local consumption.

The malguzari system was abolished in 1950 post-Independence and 186 tanks with a capacity for irrigating 100 ha or more each were handed over to the irrigation department, while the remaining tanks with an irrigation capacity of less than 100 ha were handed over to the local zilla parishad bodies. farmers were allowed to use the water without any charges.

1.1 "Phad" System

In north-western part of Maharashtra, a community irrigation management system prevails known as "Phad" system. The system came into existence in the early 16th century. The system is operative on three rivers in the Tapi basin- Panjhra, Mosem and Aram- in the districts of Dhule and Nasik. An important feature of this system is the existence of large capacities of the canals in relation to the irrigation requirements. The capacity of the canal is practically constant from the bandhara down and including the distributaries, which means that capacity factor (ratio of actual capacity of the canal to the capacity required as per crop water management) increases from head of the canal. This design provides a better flexibility of operation at the phad level.

The principal conflict in irrigation arises when there is a scarcity of water. In the Phad system, the area for irrigation is earmarked in relation to average annual water flows rather than flows in good years. The area to be irrigated in years of plentiful water flows is in an extended area, so that the farmers in this extended area know that they would get water once in few years. This area of unassured irrigation is not interspersed with the assured area and is invariably at the tail.

2. EFFORTS BY GOM FOR WUA:

Maharashtra is known as leading state in formation of WUA (Water User Association). After independence and formation of state, Government of Maharashtra (GOM) has taken large efforts to promote participation of end user farmer in irrigation water management. This was through formation of WUA and handing over irrigation project or part of it to WUA for water management.

(a) GOM, in 1976 by Maharashtra Irrigation act, promoted registration of WUA under relevant acts.

(b) In 1993 WALMI took imitative to formation of WUA and started conducting training for formation of WUA. WALMI published book and developed a video CD for guidance.
(c) In 2001 by resolution GOM compelled participation of stakeholder farmers and formation of WUA during construction of canal.

(d) GOM published State Water Policy in 2003, in which formation of WUA was given prime importance.

(e) In 2005 by MMISF act and in 2005 by MWRRA act GOM enforced formation of WUA by acts.

(f) To encourage WUA and to inspire good governing WUA, the GOM has started giving awards for WUA. These awards are given at state and regional levels since 2009-10.

(g) Since 2005 to 2014 GOM implemented MWSIP (Maharashtra water sector improvement program) with the help of World Bank in which separate mission was taken for formation of WUA and handing over irrigation project management. In which international consultant was appointed to monitor.

(h) Separate mission of IEC (information education and communication) was also implemented to promote the objective.

(i) Resolution “to give machinery of the mechanical wing of WRD to WUA at concessional rate for canal maintenance.

(j) High level committee under chairmanship principal secretary CADA for WUA is formed which comprises representatives from various NGOs and WUAs. In 2013 the GOM has opened one separate state level wing (WUA cell) under DIRD (Directorate of Irrigation Research and Development) for monitoring.

3. NEED AND OBJECTIVE OF PIM:

The experience over the last two decades shows that if farmers actively participate in the irrigation management there is marked improvement in water utilization efficiency. With participation, there is increase in the area under irrigation and also in number of farmers who gain access to irrigation. Co-operation between farmers can be increased and many water related disputes get sorted out due to participatory approach.

Following are objectives of formation of WUA and handing over the irrigation water management to them:

(a) Create a feeling of ownership in stakeholder farmers to achieve maximum productivity with optimum water.

(b) To promote equitable water distribution

(c) To maintain irrigation system

(d) To increase agricultural production

(e) Efficient use of water

(f) To reduce gap between ICA created and utilisation

(g) To promote micro irrigation methods

(h) To secure irrigation and agricultural interests of members in command area

(i) To promote and secure other common interests of members in command area
4. MAHARASHTRA MANAGEMENT OF IRRIGATION SYSTEM BY FARMERS ACT 2005:

In July 2001, Government of Maharashtra had taken policy decision to supply water for irrigation through water user association only (with time frame). The supply of water will be on bulk volumetric basis. Farmers have freedom to grow any crop within the water quota given to Water User Association.

To empower water user associations, Government of Maharashtra had enacted Maharashtra Management of Irrigation Systems by Farmers Act 2005 (MMISF, 2005). The participation of farmers is not only for management of system but farmers are also involved in planning, construction of minors also.

Main features of Maharashtra Management of Irrigation System by Farmers 2005 Act:

- Water for irrigation shall be supplied to WUA’s only
- Water will be supplied on volumetric basis
- Water user associations have freedom of cropping pattern
- Adequate representation to tail enders and women members is provided in the Management committee of Maharashtra Management of Irrigation System by Farmers 2005 Act.

For ongoing works the participation of Water user association is mandatory. The work of distribution system having discharge capacity not exceeding one cubic meter per second shall be carried out only after constituting Minor Level Water Users Association.

5. MAHARASHTRA WATER RESOURCES REGULATORY AUTHORITY ACT 2005:

The act formed for establishment of the Maharashtra water resources regulatory authority aims to regulate water resources within the state of Maharashtra, facilitate and ensure judicious, equitable and sustainable management, allocation and utilization of water resources and fix the rates for use of water for agriculture, industrial, drinking and other purposes.

The authority has the following powers to perform the following functions:

- To determine the distribution of Entitlements for various Categories of Use and the equitable distribution of Entitlements of water within each Category of Use on such terms and conditions as may be prescribed;
- To enforce the decision or orders issued under this Act;
- To determine the priority of equitable distribution of water available at the water resource project, sub-basin and river basin levels during periods of scarcity;
- To establish a water tariff system, and to fix the criteria for water charges at sub-basin, river basin and State level after ascertaining the views of the beneficiary public, based on the principle that the water charges shall reflect the full recovery of the cost of the irrigation management, administration, operation and maintenance of water resources project;
- To administer and manage interstate water resources apportionment on river systems, of the State;
• To review and clear water resources projects proposed at the sub-basin and river basin level to ensure that a proposal is in conformity with Integrated State Water Plan and also with regard to the economic, hydrologic and environmental viability and where relevant, on the State’s obligations under Tribunals, Agreements, or Decrees involving interstate entitlements.

6. PRESENT STATUS OF WATER USERS ASSOCIATION IN MAHARASHTRA

Following table shows the formation status of water user associations in state

<table>
<thead>
<tr>
<th>Stages</th>
<th>MMISF 2005</th>
<th>Co-operative Act 1960</th>
<th>Total</th>
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<tr>
<td></td>
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<td>CCA (ha)</td>
<td>No</td>
</tr>
<tr>
<td>Functioning</td>
<td>2120</td>
<td>888418</td>
<td>773</td>
</tr>
<tr>
<td>Registration done but Agreement yet to be done</td>
<td>1406</td>
<td>556552</td>
<td>519</td>
</tr>
<tr>
<td>Agreement done yet to be Functioning</td>
<td>-</td>
<td>-</td>
<td>97</td>
</tr>
<tr>
<td>Proposed</td>
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7. SOME ASPECTS SUPPORTING PIM

7.1 Group Farming:

Group farming has become inevitable in Maharashtra as 78 per cent farmers have small and marginal landholding. According to the group farming policy, it would be mandatory for at least ten farmers to come together with a cumulative land holding of 100 acres. To make group farming a success, there would be guidance on the crop pattern and technique of farming. Technology would be adopted to promote scientific farming. It would be a significant step to make agriculture economically affordable and sustainable specially among the small and marginal farmers.

There are 1.36 crore farmers in the state. Of them, 44 lakh are debt-ridden and have been out of the institutional credit system for the last five to seven years. The state government’s loan waiver scheme will help these 44 lakh farmers.

The Maharashtra cabinet approved for promoting group farming as a model to double farm production by 2022. Every year, 200 farmers would be shortlisted for group farming with financial incentives up to Rs 1 crore to each group.

The decision to provide Rs 1 crore incentive for group farming on 100 acres of land, it is believed, would help bring down investment expenditure and double the yield.
Another reason for promoting group farming was shrinking landholding in the agriculture sector. Till now about 1,200 groups set up covering 40,762 farmers.

The agriculture land holding records states, “An average land holding of 4.28 hectares in year 1970-71 declined to 1.44 hectares in the year 2010-11.” In some places, it has been reduced to just 11 to 15 gunthas.

The biggest advantage of group farming would be to help individual farmers to collectively shoulder the investment expenditure. Since farming would be on 100 acres, it would enable them to make maximum use of machines and technology at a reasonable cost. Individual farmers with small land holding not exceeding 5 acres find it extremely difficult to adopt technology or machines as it multiplies overall investment expenses.

7.2 Contract Farming:

The Government of India's National Agricultural Policy envisages that private participation will be promoted through contract farming and land leasing arrangements to allow accelerated technology transfer, capital inflow and assured market for crop production, especially of oil seeds, cotton and horticultural crops. National Agricultural Policy of GoI has also recognised contract farming as an important aspect of agri-business and its significance for small farmers.

The Inter-Ministerial Task Force on Agricultural Marketing reforms observed that contract farming was becoming increasingly important. NABARD’s Initiatives in contact farming Recognising the potential and benefits of contract farming arrangements in the agriculture sector, NABARD took the important initiative of supporting such arrangements by the banking sector and developed a special refinance package for contract farming arrangements (within and outside AEZs) aimed at promoting increased production of commercial crops and creation of marketing avenues for the farmers.

7.3 Pipe Distribution Network For Irrigation:

Conventional irrigation methods are surface gravity open channel systems such as furrows, basin, border etc. with field application efficiencies of 60 to 70 percent. The Overall Project Efficiency (OPE) of such irrigation project, at the design stage itself turns out in the range of 40 to 50 percent. But, in fact, due to various constraints the OPE during operation is only 20 to 35 percent.

As almost entire system is buried, there is considerable saving in land acquisition cost. The losses due to seepage, evaporation, thefts can be avoided by
implementation of PDN. By use of PDN, Part of un-command area can be brought under irrigation. Low maintenance cost- in PDN continuous maintenance is not required as in case of earthen channel. Advanced technologies such as drip, sprinklers, sub-surface irrigation system of irrigation can be implemented. Irrigation principle may be achieved by equitable water supply from tail to head. These are advantages of PDN over the CDN system.

7.4 Micro-Irrigation

Micro irrigation is a scientific method of irrigation carrying desired water and nutrients direct to the root zone of the plant, drop by drop. Micro-irrigation is the slow, frequent application of water directly to relatively small areas. Water is generally run through low-pressure, flexible plastic tubing. A leading advantage of micro-irrigation is that non-beneficial evaporation is greatly reduced when compared to sprinkler irrigation.

Compared to overhead irrigation systems, micro-irrigation can provide some added measure of reduced risk, Because of its high efficiency it allows for flexibility in the timing and amounts of applied water, Less water is applied so nutrient leaching is reduced, Nutrient applications can also be better timed to meet plant needs, Allows for the use of polyethylene mulch, Micro-irrigation can be used to protect small horticultural crops from freezes.

The reduced wetting of soil surfaces and plant canopies may result in lower weed and disease pressure. The leading agronomic benefits of micro-irrigation are Uses less water, Reduces pest problems, Surface crusting is reduced, Joint management of irrigation and fertilization, Low pumping needs, automation (reduces labour costs), and flexibility all have positive impacts on production costs. Drip irrigation systems can be useful for several years.

Considering the lack of water available due to Rainfall irregularities worldwide, increasing population, rising demand from various Industries, Water Resources Department is kindly appealing to farmers to use micro irrigation system for all crops.

8. CONCLUSION:

Maharashtra has long tradition of Participatory Irrigation Management. In 1990s Water Users Associations (WUAs) were formed in irrigation projects on pilot basis, but as of now WUAs are formed in length and breadth of the State. As of today around 2893 Water Users Associations (WUAs) are functioning in Maharashtra State. GOM has initiated series of reforms to strengthen PIM. A separate act (MMISF Act - 2005) has been enacted to provide legal backing to WUAS.

The water for irrigation is supplied volumetrically through WUAs only and there will be legal agreement between WUA and competent authority. The act adequately empowers WUAs to discharge their functions with delegating appropriate powers of canal officers to WUAs. The State has gone further in providing water use entitlement to individual farmers and establishment of independent water resources regulatory authority to ensure judicious, equitable and sustainable management of water resources of the State.

Though Maharashtra’s approach to PIM has been swift so far, the reforms are taking place and changed mindset of officers of WRD and farmers, PIM could lead to sustainable irrigation management
9. **SUCCESS STORIES:**

Government of Maharashtra has introduced Punyashlok Ahilyadevi Holkar Award for Water User Association in the year 2009 mainly to encourage the farmers to adopt the best Participatory Irrigation Management practices. Awards are conferred at state level and regional level. On regional level 1st and 2nd prize for each region with award money of Rs. 3 lakh and Rs. 2 lakh resp. On state level, there are three awards with prize money of Rs. 7 lakh, Rs. 5 lakh and Rs. 3 lakh resp for 1st, 2nd and 3rd winners.

Following is the success story of water user association who has received above award.

10. **SHIVSHAKTI WATER USER ASSOCIATION**

Shivshakti Water User Association No. 60 Nighoj Tal. Palner, Dist. Ahmednagar has received State level Punyashlok Ahilyadevi Holkar, Water User Association Management Award (3rd best) in the year 2010-11

**Key highlights of Water User Association:**

- Name of the project: Kukadi
- Working area: Kukadi Left Bank Canal 42 kms., Minor no. 20
- Date of transfer: 24/12/2008
- Area under cultivation: 249 Ha.
- No. of Farmers beneficiaries: 316 (252 male, 62 female)
- Flow capacity: 11.5 Cusecs
- Water Measurement Tool: CTF
- Yearly water entitlement of this association: 1.323 million cubic meter
- Water used in year 2009-10: 1.162 million cubic meter
- Irrigated area in year 2009-10: Rabbi – 179 Ha.; Summer – 175 Ha.
- Other Water conservation Structures: Farm pond -2 & wells -74.

**Water charges Recovery:**

- By Government to WUA = Rs. 0.61 lac
- Water recovery by WUA from beneficiaries = Rs. 0.87 lac
- Water charges paid to Government = Rs. 0.61 lac
- Total profit in the year 2009-10: Rs. 0.26 lac
- Audit class in the year 2009-10: ‘A’ class
<table>
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<th>Crop</th>
<th>Hectare</th>
<th>Production Quintal / Ha.</th>
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<td>Groundnut</td>
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<td>Onion</td>
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<tr>
<td>5</td>
<td>Jowar</td>
<td>20</td>
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</tr>
<tr>
<td>6</td>
<td>Chickpeas</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>Wheat</td>
<td>24</td>
<td>35</td>
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<table>
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<th>Sr. No.</th>
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<tr>
<td>1</td>
<td>Grapes</td>
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</tr>
<tr>
<td>3</td>
<td>Orange</td>
<td>18</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>Custard Apple</td>
<td>22</td>
<td>180</td>
</tr>
<tr>
<td>5</td>
<td>Sweet Lime</td>
<td>6</td>
<td>270</td>
</tr>
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**Irrigated area in year 2009-10 by Flow Irrigation**

**Association’s Remarkable work:**

- Involvement of beneficiaries including women in association’s daily working and water management.
- All cash crops in association’s command area are irrigated only by Drip or Sprinkler Irrigation method.
- Construction of farm ponds to provide water between 2 successive rotations.
- Export of grapes & other fruits from association’s command area.
- Providing technical guidance & encouragement to start milk dairies, Vermicomposting, nursery & other farm supporting businesses to beneficiaries of association.
- Timely support to maintain beneficiaries’ health & to raise their living standards.
- Cultivation of Tamarind plants for association’s permanent income source.
KASHAFROOD RIVER, MAIN DRAIN OR STREAM OF LIFE

M. Zare Bahari

ABSTRACT

The Kashafrood River is a seasonal stream and located in the northeast of Iran. Many reasons made river more and more drought, which includes population grow, reduction of rainfall, construction of dams, and increase of agriculture lands and change of crop pattern.

It passes adjacent the Mashhad, the second largest city of Iran, located near Kashafrood River, which has been lead to the following environmental damages for the river:

(a) collected sewages of the city is left in the river in the few reaches of it
(b) Discharge of synthetic sewage of adjacent industries into the river
(c) local people occupy the flood way fringe and even flood way for private use.
(d) inhabitant near this river irrigates their farms with sewages even for human food.

Therefore live seasonal river has been transformed to an abandoned filthy place; catastrophe is completed by the role of the main drain of this city.

In addition, the major amount of drinking water of the city is extracted from Kashafrood aquifer, due to misuse of aquifer, the water level has been decreased rapidly during the last 4 decades especially in the top of the aquifer (water level reached the bed rock in some wells).

The authority was decided to deal with this disaster; so, master plan or multipurpose project was defined to cover different issues.

It was included:

(a) Free occupied lands
(b) building waste water treatments for industry and human sewages
(c) holding green land in the both sides of the river

Unfortunately, Water Users Associations (WUA) have not been established for Kashafrud River, therefore assessments of decision makers and authorities were formed without any negotiation with irrigation and agriculture parts and deal with problems hold in monologue way.

Although the main issue of Kashafrud River was lack of IWRM (integrated water resources management), but require to WUA has been clarified and obvious.

Keywords: IWRM, WUA, Kashafrud River.
1. INTRODUCTION

In the Northeast of Iran, Kashafrood river, with 290 kilometers length, flows from Northwest to Southeast of the river basin. This stream and its aquifer have been responsible to supply both potable and agricultural water of Mashhad plain and the city, the second biggest city of Iran, during the past few decades. In fact, life in this area is dependent on Kashafrood stream and its aquifer.

![Figure 1. Location of Kashafrood River and basin in Iran](image1.png)

![Figure 2. Kashafrood River, its basin and Mashhad city](image2.png)

Irrational population growth along with excessive intake of water resources have resulted not only the river as abandoned and the aquifer facing with vital danger, but also sewage disposal and many environmental issues, have made it as the main drainage of Mashhad city.

This paper while focusing on the runoff decrease reasons converting the stream to the main drain, gives out some experimental clues and guiding approaches which are then discussed to come to final assessment and conclusion.

2. DECREASE OF DISCHARGE AND RUNOFF OF KASHAFROOD RIVER

Different factors effective on the decrease of Kashafrood River discharge and runoff are mentioned below:

2.1 Population growth and city expansion

Population of this basin raised up to 3008447 2006(1385 IRIN Census) from 666324 in 1966. The major part of this boost occurred in urban areas especially metropolitan city of Mashhad that contains 81% of the whole basin population equivalent to 2427726.

Along with population growth, city boundaries have extended outwards during the last three decades, growing more than 7 times.
2.2 Reduction of precipitation and surface runoff

Checking precipitation condition in the basin shows that the average rainfall in the past 10 years has decreased in comparison with the former periods. It may be expected that the runoff drops with the same rate but using a simple analysis indicates that the rate of runoff reduction is a lot more. The runoff is the result of net rainfall after subtraction of real evapo-transpiration. In recent years, global warming causes evapo transpiration rise, however, even with the assumption of constant evapo transpiration, rate of runoff decrease is a lot more than that of the rainfall.

As shown in the above chart, average annual rainfall is 268 millimeters in the first period with real evapotranspiration of about 220 millimeters, leaving 48 millimeters for runoff. By reduction of rainfall to 230 millimeters (in the past decade), real evapotranspiration is 210 millimeters and the runoff will only be 20 millimeters. More precisely, by 15% rainfall reduction, the runoff will be reduced around 50% or more.

2.3 Multiple constructions of dams (potable and agriculture)

Dozens of dams have been executed on the streams of this river with the aim of supplying water for Mashhad city and development of agriculture. The most important and huge ones are 3 dams are Kardeh, Torogh and Ardak with the capacity of 90 Million cubic meters.
2.4 Expanding cultivation area and changing crop pattern

According to studies, cultivation area is increased from 100 thousand hectares in 1972 to 119 thousands hectares in 1983 and 140 thousand hectares in 2006. Parallel to this expansion of cultivation area, cropping pattern has experienced severe changes so that the proportion of the low water consuming products like cereal is reduced from about 72% in 1972 down to 67% in 1983 and 52% in 2006. Along with decrease of the portion of the cereal in cropping pattern, the portion of high water consuming summer products like beet, orchards and so on were increased from about 25% in 1972 to 33% in 1983 and 48% in 2006. Although increase of water consumption due to expansion of cultivation area and change of crop pattern has been issued aquifer, but surface water and aquifer have severe relation, so any problem in aquifer affect discharge of Kashafrood river.

Population growth, city expansion and rainfall reduction have all occurred concurrently with constructing of multiple dams, 50% increase of cultivation area and the crop pattern change ending up to disastrous drop of Kashafrood River water discharge.

As shown in the following diagram, average flow of the river is reduced from 1.95 m³/s down to 0.62 m³/s during the last ten years.

![Discharge graph of Kashafrood River](image)

**Figure 5.** Discharge graph of Kashafrood River

3. ENVIRONMENTAL ISSUES AND CONVERSION OF KASHAFROOD RIVER TO A DRAIN

3.1 Water table drawdown

Along with more exploit surface water, Aquifer has been exploited more than its potential. This trend has resulted in a drop of more than one meter of the water level of the aquifer per annum.

As it is forecasted, population growth of Mashhad will cause the population of the city to be four millions by the year of 2021. More demand of agriculture and drinkable water sectors will make extra stress. Aquifer is result of infiltration of rainfall and Kashafrood's runoff, Mashhad plain lives by Kashafrood River and aquifer. If current exploitation continues, the plain of Mashhad will be dead in near future. Destruction of Mashhad plain caused by diminishing its aquifer and subsidence of the plain land is not only an economical disaster but it will be end up to a tremendous environmental disaster as well.
3.2 Increasing of the application of fertilizers, and chemical pesticides

Concurrent with agricultural development, application of fertilizers and pesticides in order to raise the amount of the harvest brought destructive impacts about to the environments in the study area. Fertilizer consumption was tripled from 80 kilograms in hectare in 1974 to 260 in 2003. These pesticides remain in the environment for many years having irreversible effects in polluting water, soil and air.

Simultaneous with reduction of water resources, application of these chemical pesticides will exacerbate the problem and cause even greater pollution. Because drainage of agriculture deposit in Kashafrood River without any treatment, finally infiltrate to aquifer. For instance, nitrate level is twice of its permitted level in some drinkable water wells. Fertilizers and pesticides will remain in environment and pollute soil, water and even air for long times.

3.3 Lack of Mashhad integrated Sewage network and suitable treatment plants

Despite of Mashhad city expansion, sewage network and treatment is uncompleted, and the collected sewage is disposed in Kashafrood River.

In locations not connected to the main sewage system, the waste is disposed traditionally into domestic sewage wells, eventually leaking to aquifer and causing more pollution.

![Figure 6. Disposal of sewage in Kashafrood River](image)

3.4 Disposal of municipal and industrial waste into Kashafrood River and its reuse for agriculture

Concurrent with city expansion, many industrial sites have been developed in the neighbourhood and their resulting sewage is disposed into Kashafrood River without any treatment.

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2 Integrated Water Resources Management

IWRM is an approach in which water, soil, land and relevant resources are all experiencing concurrent development and the purpose is to optimize economic and social welfare results in equal sense without any compromise to ignore the vital system stability. IWRM is an integrated approach towards development and management of water covering both resources and future services.
Figure 7. Sewage transmission line passing through school (Govareshkei village)

This sewage is used by the neighboring farmers without any rehabilitation which causes pollution to be spread in lands, villages, houses around river, as well as products like vegetables, fruits and so on, that unfortunately ends up to production and distribution of unhealthy agriculture products.

Based on official records, around 140 sumps are used to irrigate agricultural products in Kashafrood basin.

Figure 8. Conveyance Sewages (Kardeh village)

3.5 Illegal occupation of river margin lands

Agricultural development causing reduction of desired farmlands simultaneous with drop of river flow and disposal of sewage in the river have brought about the idea of occupation of the river surrounding lands and even the bed by the neighboring residents.

On the other hand, Mashhad city expansion and increase of land prices have resulted indifference to environments and unpermitted settlements around the river.
4. Discussion

Regarding study in environmental aspects, current issues are raised due to following:

Pollution due to population growth

(a) Disposal of waste into the river by neighboring inhabitants
(b) Reduction of water in dry seasons and increasing agricultural water demands
(c) Pollutions due to fertilizers and pesticides
(d) Therefore, it can be concluded that all problems relate to population growth during last decades. This irrational growth rate is because of governmental policy to raise population and immigration of many people during and after the war for work and safety opportunities

Following approaches may address these problems:

a- Paying attention to unconventional water as below:

- Effluents of urban, rural and industrial sewage treatment plants
- Drains of agriculture
- Brakish groundwater resources
- Salty resources like sea water
- Municipal runoff due to precipitation

b- Study, design and implementation of separate supplement and distribution for water demands of green area of city by usage unconventional water from wastewater treatments.

c- Establishment of artificial recharge system for aquifer by excess sewages especially in low water consumption irrigation times and trying to raise aquifer balance by considering whole healthy and environmental aspects

d- Execution and development of natural ponds for additional excess sewages to apply in critical times with taking into account all environment standards

e- Substitute all agricultural water rights downstream of big dams such as Torogh, Kardeh plus the wells with treated effluents considering all environmental principals

f- Collection and transmission of municipal runoff to natural ponds such as wetlands and apply for artificial recharge of groundwater table and irrigation
5. CONCLUSION

Finally, continuous environmental issues of Kashafrood River are due to the following issues:

(a) Multi sectored decentralized decision makings
(b) Lack of sufficient knowledge of authorities and stakeholders about the vital role of river basin and river issues especially environment problems
(c) Lack of comprehensive data for demands, potentials and planning
(d) Lack of enough will and decision

Obviously, environment issues cannot solve without review of background problems. Comprehensive solution of Kashafrood River depends on integrated management of its basin.

Gaining widespread popular participation and sustainability of this partnership are, in the long run, one of the main criteria for IWRM. Participation involves all stages of planning, implementation, operation. This partnership is usually provided when the benefits of the project are convincingly higher than the loss of it for the people. In other words, people participation and cooperation depends prior to anything else, on their justified calculations. If the project planning is based and focused on people satisfaction, that brings significant benefits to all social strata in the short term, and, in the long run, provides a perspective of sustainable benefits for the locals, then it can be regarded as a desired factor in drawing public participation. People are considered as the axis of development and their participation is counted as a precondition for the success of a country’s policies and programs. Participation through the organization of groups extends the social investment of society and is a mechanism that empowers small and marginal groups to play a more influential role in the context of the mainstream of their social life.

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