Australian Aid

IRRIGATION SUB SECTOR GROWTH STRATEGY IN EAST JAVA

February 2016

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Abbreviations

AIP-PRISMA	Australia-Indonesia Partnership for Promoting Rural Income through Support for Markets in Agriculture
EJ	East Java
GOI	Government of Indonesia / Central Government
MoA	Ministry of Agriculture
MoPW	Ministry of Public Works (Kementrian Pekerjaan Umum)
ESDM	Ministry of Energy and Mineral Resources (Kementrian Energi dan Sumber Daya Mineral)
DPUP – Province	Dinas Pekerjaan Umum Pengairan Provinsi = Provincial Irrigation Office
DPUP - District	Dinas Pekerjaan Umum Pengairan Kabupaten = District Irrigation Office
BBWS Brantas	Balai Besar Wilayah Sungai Brantas = Irrigation Office specifically handling Brantas River Basin
WUA	Water User Associations (Himpunan Petani Pemakai Air/HIPPA)
PJT	Perum Jasa Tirta = Jasa Tirta Public Corporation
Ha	Hectares
m3	Cubic metres
MT	Metric tonne
M4P	Making Markets Work for the Poor

1. Executive Summary

Irrigation is crucial for crops production, particularly during dry season. A well-managed irrigation is able to boost the cropping intensity, increase crops capacity through production of higher value crops (especially during dry seasons), and reduce the risks of failed crops. This is more prominent in food crops such as rice and maize which have higher usage of water. For instance, farmers in East Java are only able to get 6 metric tonnes yield per hectare during dry season because water is limited; should there be sufficient irrigation, they would be able to add minimum 2 metric tonne yield. If farmers initially only plant 1 or 2 times per year during rainy season, with adequate water they would be able to increase their cropping frequency, planting 3 times per year. This suggest potential additional income for the farmers.

Farmers in East Java mainly use surface irrigation during rainy season and only few use groundwater during dry season. Only 10% of the available groundwater in the province have been used thus far. Despite the huge potential of this water source for irrigating farmlands, many farmers do not have the knowledge nor capabilities to utilise groundwater efficiently and effectively. During dry season where surface water (rivers, canals, dams) becomes dry, most farmers build shallow wells to extract water from ground, although there is limited water available from these wells as it is used by most households. Whilst there is bigger and better opportunity to utilise groundwater from medium and deep wells, extracting water from medium and deep wells are relatively more difficult and expensive for farmers.

The Government of Indonesia regulates public irrigation through participatory management system and took some steps to address the problems in irrigation occurrences. However, the coordination and the efforts to improve the public irrigation system in the country are still challenging. On the other hand, irrigation is hardly known to private providers. Consequently, water supply is still inadequate to irrigate farmlands and many farmers are still struggling to obtain consistent harvest and to increase productivity. Participatory management system organise public irrigation based on land size and responsible authorities where the water user associations (WUAs) are in charge for managing irrigation at the villages (tertiary irrigation) while the local and national government handle the secondary and primary irrigation. This is intended for both surface and groundwater irrigation. On the other hand, although private investors are allowed to participate in the sector, particularly in tertiary irrigation, this practice is still rarely found. Successful story from one WUA Tirtotanoto in Tuban who cooperated with private investor in improving the local irrigation is a good example for other players to take part in the investment.

Based on the market analysis, it was concluded that a combination of poor management in public irrigation infrastructure by the WUAs, limited number of private irrigation providers and limited development of irrigation infrastructure prevents farmers from obtaining adequate water supply for their farmlands. As the organisation and capacity building for the WUAs are weak, they have not been able to manage the irrigation system and infrastructure properly. From the private investors' side, investment in deep-well groundwater which is profitable and valuable during dry season is costly and there is hardly any financial institution that can provide financing service for such investment. On the other hand, government planning and budgeting are still weak as they do not prioritise irrigation despite the potential

benefit for the farmers and bigger society. Overcoming these main problems would greatly benefit the farmers in increasing their productivity.

The vision of change for the sub-sector is increased farmers' land productivity during dry season through improved irrigation access and enhanced irrigation system. At the service level, it is envisaged that farmers have better water supply during dry season through: 1). increased availability of irrigation services, 2). higher quality of public irrigation services and 3). improved irrigation infrastructure. Increase availability of irrigation services demonstrate an increase number of private irrigation providers since currently there are very limited number of them. Simultaneously, it is crucial that public irrigation providers improve their service quality, especially in coordinating the water distribution for irrigation and relevant irrigation programs. Further, it is expected that the relevant government put more attention in improving the irrigation infrastructure, both in developing new infrastructure and in maintaining the existing ones.

Four interventions are recommended to achieve the vision:

1. **Promote provision of financing on groundwater irrigation.** The intervention is intended to support the provision of groundwater irrigation through cooperation with private financial institution who will provide the financing services.
2. **Promote groundwater irrigation service that can be embedded to core agriculture input business.** The intervention is intended to support agriculture input companies as they will be able to provide irrigation service combined with the inputs (seeds, fertilizer) to secure consistent.
3. **Facilitate organisational and capacity development for the WUAs.** This intervention will include cooperation with relevant government bodies in improving the WUAs' capabilities in managing the tertiary irrigation.
4. **Increase advocacy to the GOI to make better planning and budgeting for the improvement of the secondary irrigation infrastructure.** As the secondary irrigation has strong influence on the availability of water for crops production in tertiary irrigation, the intervention will attempt to support the government in making a better planning and budgeting

2. Background

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The Australia-Indonesia Partnership for Promoting Rural Income through Support for Markets in Agriculture (AIP-PRISMA) is a multi-year program which is part of the Government of Indonesia's midterm development strategy to accelerate poverty reduction through inclusive economic growth. With the support of the Government of Australia, the program aims to achieve a 30% increase in the net incomes of 300,000 male and female smallholder farmers in eastern Indonesia by 2018. PRISMA works in East Java, West Nusa Tenggara (NTB), East Nusa Tenggara (NTT), Papua, and West Papua.

This Report aims to provide a logic and rationale for market-based interventions which can support the irrigation sector for the benefit of male and female smallholder famers in East Java (EJ). The original idea of the irrigation sector is derived from direct observation on farmlands across EJ where the need for adequate water supply still prevalent in the province.

3. Sector Description

3.1 Sector Profile

The sector profile provides information regarding the current status and potentials of the irrigation sector. This has been sourced from primary and secondary data relevant to the sector.

3.1.1 Overall Context

Irrigation is the most important input that determines crops productivity.
As stated by the Ministry of Agriculture (MoA), crops productivity is highly impacted by irrigation (16%), compared with other inputs such as fertilizers (4%) and varieties (5%), which is more evident for food crops such as rice and maize (Nuchsin 2014). A good irrigation management is able to boost the cropping intensity, increase crops capacity through production of higher value crops (especially during dry season), and reduce the risks of failed crops.

Irrigation is critical for food supply in Indonesia as 85% of national rice production comes from irrigated agricultural lands.
From roughly 192 million hectares (ha) of total land area in Indonesia, around 40.7 million ha (22%) are agricultural lands which are dedicated for rice crops production (Kompasiana 2014 from the Ministry of Agriculture). Water needs for rice production is higher compared with other food crops such as maize and soybean. Whilst nearly 95% Indonesians consume rice as staple (Agrofarm 2014), ensuring adequate irrigation to support rice production is very important. Moreover, the Government of Indonesia (GOI) self-sufficiency of food programs by 2018 would further impact to the increasing water usage for agricultural lands, suggesting the crucial needs for efficient irrigation systems.
In particular, about two thirds of the 31 million population working in agriculture sector are poor, who mainly grow rice as their primary crops. Improvements in irrigation system accordingly would benefit these poor farmers as they would be able to increase the food production and its productivity to generate better income. Overall, a well-developed irrigation management could bring positive impact to the greater economy.

Most irrigation systems in Indonesia is sourced from surface water, while there is relatively lower usage of water from soil (groundwater).
Government Regulations regarding Irrigation (Peraturan Pemerintah tentang Irigasi) No. 20 year 2006 defined several types of irrigation, which includes surface irrigation, swamp irrigation, underground irrigation, pump irrigation and embankment irrigation. A more direct definition however, categorises irrigation based on two types of water sources: 1) surface irrigation (river, basin, lake, ponds, reservoir), which dominates the current irrigation system, and 2) groundwater irrigation, which heavily relies on water capacity in the soil. Since surface water is relatively more accessible, the development of irrigation infrastructure that encompasses canals, pumps, buildings and any equipment needed, accordingly is more focused on surface irrigation. Meanwhile, the utilisation of groundwater for farming practices is still limited, relatively less coordinated and mainly refers to the water sourced from shallow layer of the ground.

GOI regulates water resources and irrigation system through participatory management system that divides irrigation based on land coverage and responsible authorities.
Irrigation system in Indonesia (see Annex 2 for illustration) consists of 1). Primary irrigation at national and cross-province level (covers land size > 3000 ha), 2). Secondary irrigation which includes province and cross-district level (covers land size between 1000 – 3000 ha), and 3). Tertiary irrigation at the district level (covers land size < 1000). This system, according to the Government Regulations regarding Irrigation (PP No. 20/2006), mainly refers to the surface irrigation as it is more settled compared with the groundwater irrigation. In the meantime, the less-regulated groundwater irrigation is included as part of the tertiary irrigation where its emphasis is on the deep-well pumps (below 60 ha depth) under the P2AT (Proyek Pengembangan Air Tanah) Office.

The irrigation system in Indonesia allows relevant government bodies in province and district levels to manage, develop, and support the distribution of water for crops production. Provincial Irrigation Office (Dinas Pekerjaan Umum Pengairan Provinsi/DPUP-Province) and District Irrigation Office (Dinas Pekerjaan Umum Pengairan Kabupaten/DPUP-District) are the officials responsible for the irrigation occurrences at the province and district levels; whilst P2AT Office and Ministry of Energy and Mineral Resources (ESDM) are the legitimate government entities managing groundwater irrigation.

The participatory management system assigns Water User Associations (WUAs) the responsibility for managing tertiary irrigation at the village level.
In 1987, the government introduced the participatory irrigation management system designating the WUAs (Himpunan Petani Pemakai Air/HIPPA) as the primary actors responsible for the tertiary irrigation. Under the Water Law No. 11/1974, WUAs are responsible for operating, maintaining and developing tertiary irrigation system for land size < 500 ha, which has direct impact on villages and sub-villages. The responsibility also includes managing budget for operational and maintenance of the irrigation infrastructure. For this purpose, WUAs are able to collect an Irrigation Service Fee (ISF). For both surface
Perkumpulan Petani Pemakai Air (P3A) and Perkumpulan Petani Pemakai Air Tanah (P2AT) are the formal names assigned to refer to surface and groundwater WUAs. They are both called as WUAs who perform as the key players for water applications in farmlands. Meanwhile for the secondary irrigation, the joint cooperation of several WUAs known as the Water User Associations Federations or WUAFs (Gabungan HIPPA/GHIPPA) are the primary users and administrators of the secondary infrastructure.

Coordination and capacity amongst relevant national, provincial and district-level government agencies to support irrigation and WUAs is an on-going challenge.
Whilst the GOI and DPUP-Province are mainly responsible for the primary and secondary irrigation network (e.g. dams, reservoirs, rivers, main canals), DPUP-District and representative MoA at districts are the immediate government officials who are the main advisors for the WUAs in tertiary irrigation. For this purpose, the district government needs to understand the irrigation occurrences in the tertiary irrigation system (in villages and sub-villages) in order to support WUAs with proper guidance, management and additional funds where needed.
In some cases, current irrigation initiatives and existences may be part of central, provincial and district governments, be cross-functional and cross-jurisdiction programs, and sometimes may

also be the full responsibility of the villages. Jaringan Irigasi Tingkat Usaha Tani (JITUT), and Jaringan Irigasi Desa (JIDES) for instance, are the irrigation network development programs in specific villages which come from both district and provincial government. Without strong coordination, it is difficult to implement and monitor the result of such initiatives, particularly in relation with providing proper support and guidelines to WUAs in managing and implementing irrigation initiatives.

Investment from private sector in tertiary irrigation is allowed, subject to government's approval, and has the potential to improve the irrigation infrastructure and performance of WUAs.

Data from the Ministry of Public Works (MoPW) (2010) revealed that out of total 7.4 million ha of irrigated lands, 40% falls under district government authority, encompassing 31,860 irrigation systems (3,195,568 ha). Meanwhile, provincial government is responsible for 1,109 systems (1,423,222 ha), and the national government is responsible for 241 systems (2,851,006 ha). At the district level, which has the highest number of irrigation systems in tertiary irrigation, private entities are entitled to establish business activities. One successful WUA, Tirtotinoto in Tuban district, was able to form a joint cooperation with a local investor to develop irrigation system nearby Bengawan Solo river basin. After the investor rehabilitated the broken pumps, farmers were able to irrigate their lands and produce rice crops in two dry seasons. Although still rarely exist, such investment is highly recommended to improve the current irrigation system and to support the performance of WUAs. In general, the government allows investment in the utilisation of water from both surface and ground sources which is intended for agriculture.

Ministry of Agriculture estimates that currently approximately 55% of irrigation network is damaged, of which 52% is related to tertiary irrigation.

Damages in irrigation network have become an ongoing problem that hinders the agriculture productivity. Nearly one third of the irrigation network at district level is ruined or in poor condition. Recognising this, the GOI plans to rehabilitate 3.3 million ha irrigation area, build 49 new dams and 1 million ha new irrigation system for the next five years (Ministry of Public Works 2015). Similar programs in the past, however, have not been able to deliver targeted outcomes. For the period of 2010-2014, the MoPW set a target to develop 500,000 ha new irrigation network; however, only 53% has been fulfilled by the end of 2014. Therefore, it is notable to see whether the new development and rehabilitation initiatives will be implemented effectively for the next five years.

Evolving challenges prevail, leaving irrigation as an integral part of greater socio-environmental issue.

Increasing population and urbanisation which affects to soil degradation, decreasing water supply due to watersheds deprivation, land conversion, water pollution and global climate change are the remaining challenges which could affect the water availability.

As a water rich country, Indonesia ranks 15th globally as the nation having the largest irrigated lands with about 3900 billion cubic metres of yearly potential water resources (World Fact Book 2005, Ministry of Public Works 2015). It also has more than 20 percent of fresh water available across the Asia-Pacific region (Ardhianie 2015). Despite the high potentials, water usage efficiency for agriculture in Indonesia is relatively low due to a combination of inadequate agricultural infrastructure, low quality and capacity of most irrigation users and related policies

which possibly impact to the watershed capacity. Worsen by natural environmental incidences, this will subsequently decrease the water availability and its quality.
Low efficiency of irrigation also corresponds to the United Nations' Food and Agriculture Organisation's report (1995) that stated agriculture not only as the world's largest water user in terms of volume, but also as a relatively low-value, low-efficiency and highly subsidised water user. From 3,600 billion cubic metres of global average water usage per year, more than 80% are used for irrigation applications. In Indonesia alone, water necessity for agriculture practices has been steadily increasing for the past year. In 1990, the average usage is only 74.9 billion cubic metres (m3). In 2000, it surged to 91.5 billion m3 while in 2015 it is estimated that the usage would be 116.96 billion m3 (Dharma). When the increasing amount of water usage is not followed by the improvement on usage efficiency, water scarcity becomes a looming threat not only for farming, but for the whole nation's wellbeing.

3.1.2 Local Context

East Java has the largest area of irrigated wetlands in Indonesia, yet also has the largest area of dry fields and ranks 5th for non-irrigated wetlands.
EJ has 862.590 ha irrigated wetlands, accounting for 17.9 % of the total national irrigated wetlands. Meanwhile, there are 1.141.452 ha of dry fields in EJ or 9.6% of total dry fields in Indonesia, nominating the province with the largest dry field areas. In addition, there are 240.273 ha areas remain as non-irrigated wetlands in EJ, account for 7.3% of total non-irrigated lands (Ministry of Agriculture 2013, see Annex 3). The vast areas of dry fields and non-irrigated wetlands (both categorised as drylands) reveal the insufficiency of irrigation in many parts of EJ despite their potentials to be productive farmlands, demonstrating evident needs for improved and accessible irrigation.

Adequate water supply is crucial for crops production during dry season mainly in the second and third season in drylands, and in the third season in wetlands.
There are two main cropping patterns in EJ which follows the three cropping seasons in a year. First, in wetlands, farmers grow rice as their primary crop in the first wet season (Nov – Feb) and in the second wet season (Mar-Jun), followed by growing secondary crops (e.g. maize, soybean) in the third dry season (Jul-Oct) when the water supply is more limited. Second, in drylands farmers grow rice as their primary crop in the first wet season (Nov-Feb), followed by secondary crops in second dry season and third dry season. In drylands, dry season starts earlier from the second season due to lack of water. Indeed, some farmers in drylands are only able to grow crops two times in a year, namely in first wet season and second dry season because of limited water. This prevents farmers to increase production and gain income increase.
This year, from total 903 ha failed rice crops, around 533 ha is caused by drought with the most affected drylands are Bojonegoro, Lamongan, Tuban (Surahman 2015). EJ contributes to more than 17% of national food production. As one of the highest food shed, it is important to ensure the food production in EJ. Sufficient water supply hence, is critical to prevent failed crops.

More than 96% of water usage in EJ is sourced from surface water. Among the surface water sources available in the province, Brantas River is one of the most important source for agriculture practices.

Agriculture dominates the water usage in EJ. About 13% of 120 billion m3 total available water is used for crops production, followed with households' and industrial usage. Nevertheless, farmers rely heavily on water from surface water sources, such as rivers, dams or ponds. For instance, it is estimated that 126.520 ha irrigated lands in EJ receive irrigation from dams, while the remaining 829.854 ha obtain water from other surface sources (Ministry of Public Works 2010). One of the most important surface water sources is Brantas River, the second largest river in Java Island that contributes to activities of more than 15 million people. Districts such as Batu, Malang, Blitar, Tulungagung, Kediri, Trenggalek, Nganjuk, Jombang, Mojokerto, Sidoarjo, Pasuruan are some major areas covered by Brantas River Basin (Daerah Aliran Sungai/DAS Brantas). Up to year 2000, this river basin has been supplying water to about 345,000 ha paddy field. Considering its crucial role, MoPW imposes a regulative arrangement for the management and utilisation of Brantas River, along with its 40 streams. BBWS Brantas (Balai Besar Wilayah Sungai Brantas) is the authorised body established by MoPW for this purpose. In addition, a state-owned enterprise Jasa Tirta Public Corporation (Perum Jasa Tirta I/PJT I) was also assigned to manage the operational and maintenance activities related with the infrastructure of the river basin (Subijanto 2013, Perum Jasa Tirta I 2014, Ministry of Public Works 2010).

Some farmers have been using groundwater during dry season but they mainly use shallow wells where the water supply is limited.

Whilst most water is obtained from surface, only 10% of total available groundwater is utilised and only 3.34% of total usage is from agriculture. This leaves about 14.5 billion m3 or more than 90% of total available groundwater in the province that can be utilised (Ministry of Public Works 2013).

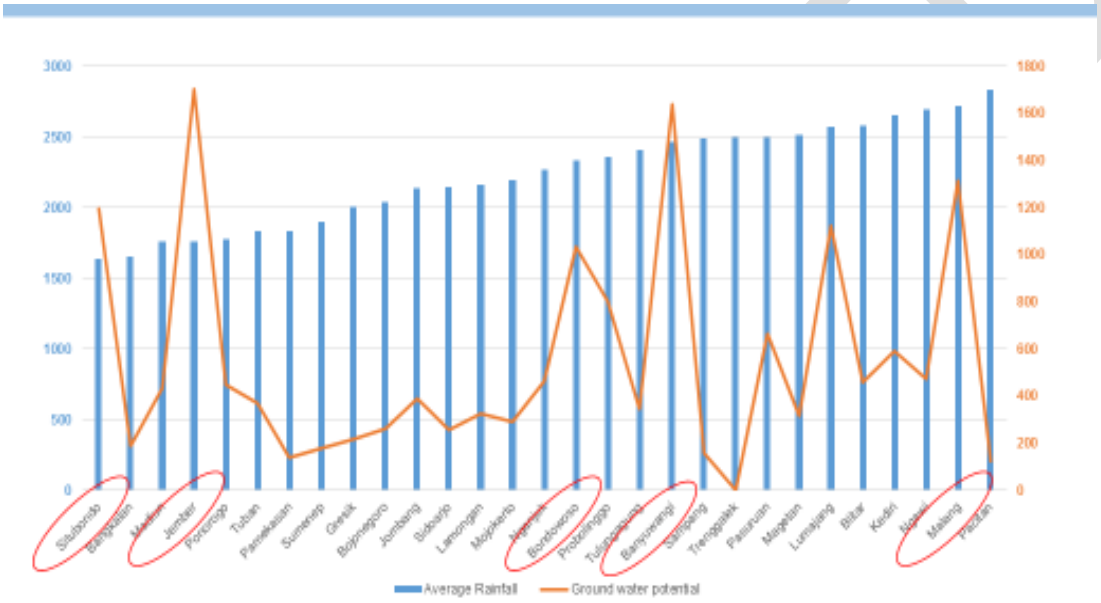
Many farmers in EJ are aware of the existence of groundwater, especially to anticipate shortage of water during dry season. However, they still have difficulty to obtain adequate water from ground. This is essentially because farmers mostly acquire water from an *unconfined aquifer*, the underground layer closer to soil surface with less than 30 meters depth. This aquifer mainly supply water for household consumption, where water is extracted through water well (usually this is defined as shallow or shallow-mid well). Although excessive water use from shallow-mid wells causes decrease of water amount in the soil and higher possibility for contamination, farmers actively source from this aquifer. In Mojokerto district, most farmers have their own pumps to get water from shallow-wells (≤ 10m depth). Some of them also charge fee for supplying water to their neighbouring farmers who do not have pumps. Using small and relatively cheap pumps, these farmers are able to water the crops despite their lack of considerations on efficiency, cost, safety, and output.

Meanwhile at the *confined aquifer*, the deeper underground layer (usually ≥ 60 m depth, extracted via deep-well), water is relatively intact since it comes from natural purification of rainfall and would be more appropriate to be used for irrigation as it does interfere with household consumption. In late 1980s, GOI through MoPW started a massive groundwater development project P2AT where it invested thousands of costly deep-well water pumps in EJ to improve the irrigation system. These pumps are able to irrigate up to 30-50 ha lands and they are most effective when operating in dry seasons. In practice, there are only few farmers in certain villages who can get access to water from the P2AT pumps during dry season due to a combination of technical problems and capacity of the operators. For farmers, it is unlikely that

they merely obtain water from deep-well groundwater since procuring the pumps, drilling and relevant equipment is costly.

Situbondo, Jember, and Banyuwangi are some of the districts with average low rainfall and high groundwater potential which can be intervened. Refer to data from DPUP-Province 2013 (see below chart), low rainfall in the mentioned three districts suggests water inadequacy that prevents farmers from receiving higher yield. As an example, lack of water has impacted to 20% reduction of maize production in Situbondo (BPS 2014). Considering the availability of groundwater in the districts, it is recommended to extract water from the soil to overcome the lack of water should there be initiative to do so.

Comparison average rainfall and groundwater potential in East Java



Although other districts seemingly have lower groundwater potentials or high rainfall, some parts of the districts still have the possibility to be intervened if the current irrigation is not sufficient to support productive farming practices. Ponorogo district for instance, is one of the major producers of maize in EJ. Its production has also decreased more than 20% in 2014 in which limited water supply contributed to the cause. Although irrigation could contribute to an increase of 2 metric ton (MT) yield per hectare, there are still limited initiatives and programs which could improve irrigation supply in the district.

Uncertainty of weather due to climate change adds to the importance of keeping the water supply for crops production throughout the year.
Global warning and climate change affect to weather pattern changes and season irregularities, which result in shorter or longer season, erratic droughts and rainfall. In Java, even without climate change, threat to water resources has already become apparent as assumed that the available water being 80% of runoff. It is expected that due to climate change, the island will suffer the most compared with other areas outside Java. In Brantas watershed for instance, demand for water already surpassed supply by 12 percent; whilst in Bengawan Solo, demand is 9% higher than the water supply. Climate change will possibly increase the demand-supply

ratio of water, suggesting the likelihood of lack of water supply from the primary watersheds in the province (Sari 2002).

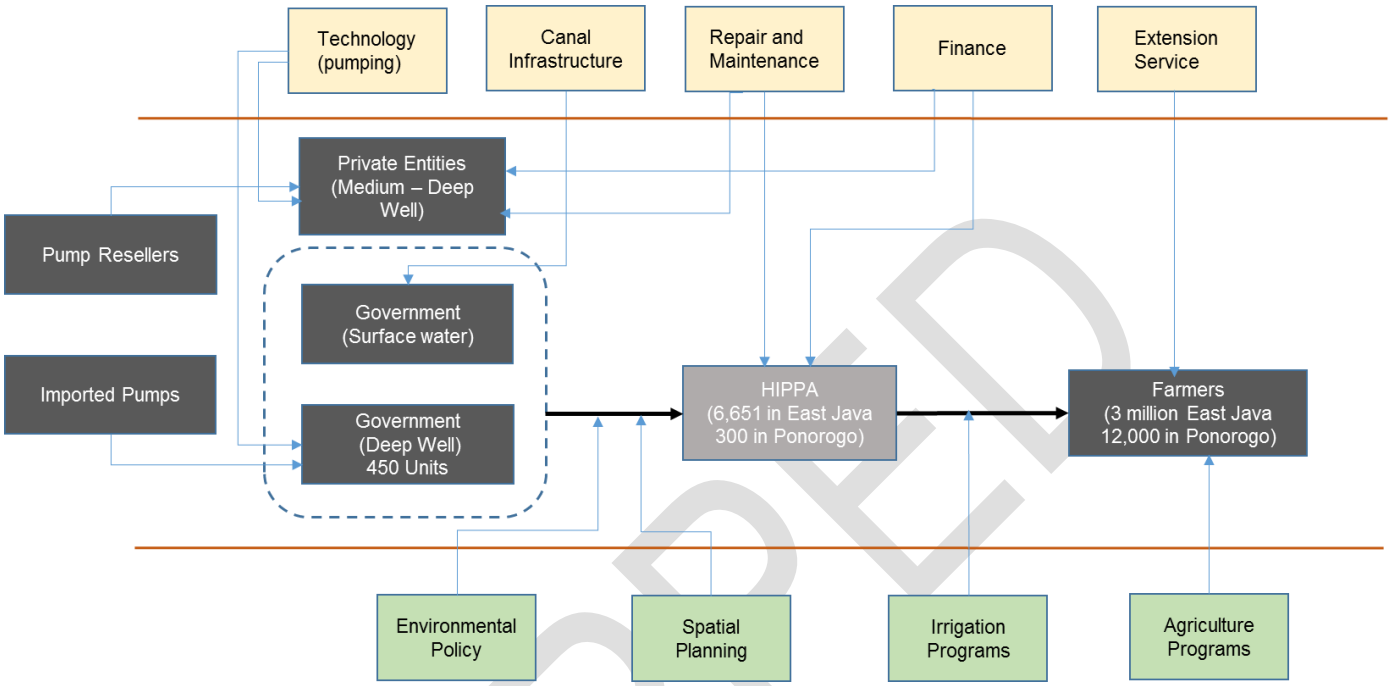
Following the outcomes of the national programs, rehabilitation initiatives for irrigation in EJ have yet to deliver the intended results.
From total 1.342.870 ha national irrigation network targeted by the MoPW for rehabilitation in 2010-2014, about 14% or 72.030 ha is located in EJ, the second largest area targeted for rehabilitation after West Java province. Meanwhile, from a total of 2.341.363 ha national irrigation network targeted specifically for maintenance and operations during 2010-2014, 309.108 ha irrigation network was located in EJ, which is the largest allocation among other provinces (Ministry of Public Works 2010). Despite the huge portion allocated for rehabilitation and maintenance, such initiatives could not meet the target by 2014; hence, this follows the negative outcomes of the national programs and plans. Furthermore, there was no scheme set for developing new irrigation infrastructure in EJ province during this period, which will eventually worsen the impact of the existing damaged network.

3.2 Sector Dynamics

3.2.1 Market Overview

Farmers in EJ acquire water to irrigate their lands mainly from two sources: 1). surface water from rivers/dams during rainy season and 2). groundwater during dry season and just before the dry season starts. Surface water is provided mainly by the government (public water providers) and managed by the WUAs at the villages, while groundwater is provided by both government and private providers.
Irrigation is more known as public sector where the government holds primary responsibility rather than the private sector. This is shown by the very few private irrigation providers available in the market. Whilst high demand for irrigation occurs both in drylands and in some wetlands during dry season, current surface and ground irrigation still cannot meet the needs of water for crops production.

3.2.2 Sector Map



.2.3 Core Value Chain

The main actors for this core value chain are the water providers (government/public and private), the WUAs (HIPPA) who distribute water in villages and smallholder farmers who use water to increase their land productivity for high yield. Both males and females are able to involve in the provision and procurement of irrigation, although the participation of females are more focus on the decision to buy the irrigation service and to plant suitable crops.

Farmers obtain irrigation from public domain or public services mainly during rainy season, yet this domain focuses more on surface irrigation and less on groundwater irrigation.

For surface irrigation, flow of water generally starts from upstream (rivers/dams) until certain water intake, then water is distributed to the districts at the secondary level through canals until it reaches the villages at the farmers' level (tertiary level). Irrigation of this kind, is generally free from charge and is used during rainy season and first dry season when surface water is still available. Farmers either get water directly from canals using plastic hose, or use small pump before attaching the hose. Sometimes in few villages, farmers contribute by paying small amount of money to support the WUA (water operator) who coordinate the water distribution based on land locations. Better management and supervision for surface irrigation is visible as government put more attention to this network.

For groundwater irrigation which is mainly critical during dry season, around 450 units of P2AT pumps have been installed and distributed to the villages and should be managed by the

relevant WUAs. Accordingly, the operations and maintenance of the pumps also become the responsibility of WUAs. In some villages where the WUAs for groundwater are active, farmers could obtain irrigation by paying certain amount of money as the irrigation service fee (ISF), charged on hourly basis. ISF per hour ranges from IDR 30,000 – 40,000, depend on the location and operational difficulties. The P2AT pump operator coordinates the use of groundwater amongst the farmers based on particular schedule and arrangement. The groundwater irrigation under P2AT scheme however, has many challenges due to its high operational costs and difficult maintenance, thus making it ineffective in supplying water to farmlands.

A limited number of private providers of surface and groundwater irrigation exists.
As mentioned previously, some private players have been taking part in surface irrigation such as in Tuban and in some other areas in EJ. For groundwater, some individuals also engage in irrigation business. In Probolinggo for example, a local individual invested electricity-powered deep-well submersible pump to provide water for the farmers in the area. Such initiatives, however, are still very rare.
In addition, some farmers have been acting as water providers themselves by sourcing water from shallow-wells using their own pumps. However, they are not aware of the potential environmental risks nor the business potentials of such activities. Most farmers focus on irrigating their own land first. Once done, some of them sell the water service by charging ISF between IDR 10,000 – 15,000 per hour. The water discharge is small and can take up to 7 hours to irrigate 1500m2 land size. As farmers do not think about business prospective of irrigation, this practice does not interest them much.

Farmers need adequate water supply mainly during dry season; however, land altitude and location also determine the types of irrigation and its infrastructure.
In uplands, it is more difficult to access water because of poor water channels in higher lands and difficulty in obtaining groundwater. Most water can be found in deeper layer on the ground which requires deep-well drilling efforts. During dry season, most farmers in uplands can only plant 1 time per season, suggesting the loss of potential income that farmers can get when water is available. In some low lands, especially those in downstream (farther from the water source) also receive less water, mainly because of insufficient water debit from the upstream and percolation process. This influence the productivity gain that farmers can achieve.

3.2.4. Supporting Functions / Services

As a service to support farming activities, the provision of irrigation is influenced by many factors. The supporting functions in this case consist of the availability and quality of the canals and pumps, along with the relevant repair and maintenance; added with the financing and extension services which can support both water providers and buyers (farmers). Meanwhile, the rules and regulations refer to the relevant government policies and regulations which may affect to the provision of irrigation, particularly which relate to the private domain.

Canals and pumps are the main infrastructure that supply water to irrigate lands.
Primary and secondary canals (primary and secondary surface irrigation) at the upstream channel water to smaller canals in tertiary level. As the primary and secondary canals have the critical function to supply water to farmlands in tertiary level, any condition in these canals will

affect to the farmers' lands. When water source in the upstream is limited, the amount of water that can reach the farmers will be limited; if the upstream canals supply contaminated water, it will possibly damage the crops and the soil. Since most surface irrigation is the responsibility of the government (public services), the condition and function of the canals should be taken care of by the government. Many times it was found that the limited water supply from the upstream causes problems at the tertiary level where many farmlands did not receive water from canals. Meanwhile for groundwater irrigation service, government also hold the responsibility to build the P2AT pumps; but sometimes without a thorough assessment of the needs and the feasibility. This causes poor service (ineffective and inefficient) of the investment.

Repair and maintenance are important activities to support the provision of irrigation. In public irrigation infrastructure this becomes the responsibility of WUAs and government.
Although WUAs are given authority to manage the fund for operations, most WUAs have limited knowledge and experience in operating and maintaining the irrigation infrastructure. This is evident especially for P2AT groundwater pumps. WUAs are still lacking in knowledge and skills in preventing rust, changing fuel, or adjusting water extraction rate for efficient service.
In the meantime, there is also shortage of skilled and capable technical staffs at the government offices who can support solve the repair problem. This further impacts to the slow handling of the damaged infrastructure.

Financial assistance is needed to support the improvement of the irrigation system, particularly in developing irrigation as a business venture.
Activities related with the procurement of irrigation would require financial support. Costs incur in developing the irrigation network and infrastructure, managing the operation and maintenance, as well as initiating irrigation as a business venture. If farmers or any individual would like to partake in irrigation business, the presence of financial assistance (loans or lease) would greatly benefit them. This is more apparent for groundwater irrigation, especially deep-well irrigation. In any case, when irrigation is developed as a business venture, potential investors would need clear information regarding the profitability and prospect of the business, suggesting the need for viable business information aligned with the financing service.

There is limited information regarding water availability and proper water usage to maximise crops productivity.
Different crops may require different amount of water and different cropping practices to maximise the results. Similar to the usage of other inputs such as fertilizer and pesticides, many farmers are not aware of proper irrigation method to achieve maximum crops yield results. Some farmers use unnecessarily too much water and some others are not equipped with information on how to obtain water from proper sources without harming the environment or household consumptions. The absence of supporting services which can provide such information nevertheless impacts to the irrigation occurrences.

3.2.5. Rules and Regulations

The government's regulation of and support to irrigation systems is spread across multiple agencies and levels, which may leads to a lack of coordination in planning and effective implementation.

There are many programs intended to improve the irrigation, whether through agriculture programs or specific irrigation programs. The programs are derived from various initiatives of the MoPW, MoA, BBWS or the GOI. In many instances, coordination among these government bodies in planning and implementing such programs is lacking. For agriculture programs designed to endorse improvement in irrigation, each government body (at central, provincial and district level) may establish separate activities and initiatives which can impact the effectiveness of overall government support to the irrigation sector.

The utilisation of water resources need to consider spatial planning and environment policy in order to avoid misuse or over-exploitation.
Government Regulations No. 23 year 1997 (Undang Undang tentang Pengelolaan LIngkungan Hidup) and 26 year 2007 (Undang Undang tentang Tata Ruang) stated that any activity, whether intended for commercial or non-commercial purposes, should consider local development planning and sustainability of the natural environment. Should the activity pose threat to environment or natural resources, government may impose penalties or sanctions if needed. In practice, excessive infrastructure development for urban housing, industrial and commercial facilities causes serious problems of land degradation, water pollution and loss of irrigated areas. Furthermore, many development projects involving the conversion of agriculture lands to non-agriculture estates (mainly industrial) are still permitted by certain government offices although their existence are against the local spatial planning. This also exacerbates the damages to natural ecosystem and threaten the sustainability of natural resources, particularly the water resources. With EJ lands vary in topography and soil condition, proper spatial and environmental assessment should be done to overcome such matters.

3. Analysis

4.1 Problems and Underlying Causes

The problems and underlying causes are specific to the targeted groups which AIP-PRISMA seeks to support through interventions in the irrigation market system in East Java. These problems have been identified through the Sector Dynamics section above and are also presented in the Intervention Logic Analysis Framework (ILAF) table.
The key problems are presented below;

- Farmers have low productivity because there is shortage of water supply during dry season
- Farmers do not get enough water supply during dry season due to:
  - Limited number of private irrigation providers that can supply water for crops production
  - Poor management of existing irrigation infrastructure by WUAs resulting in disruption the water supply to farmlands
  - Inadequate irrigation infrastructure development that can reach to drylands

Farmers have low productivity due to shortage in irrigation supply during dry season.
Lack of irrigation causes lower yield results where farmers are unable to produce high value

crops, which leads to minimum return during dry seasons. Inadequate water supply also prevents farmers to increase cropping intensity that could add to farmers' income when they are able to add crops production from two to three times or from one to two times per year. For instance, maize farmers who could only get 6 MT yield per ha with limited water, will be able to increase 2 MT yield when water is sufficient. Meanwhile, those who did not grow maize because of inadequate water supply, will be able to produce minimum 6 MT yield. Both suggest potential income for maize farmers resulting from improved irrigation supply.

There are very few private irrigation providers, especially in deep-well groundwater irrigation, despite its potential as a business opportunity.
Irrigation can be an interesting business investment if conducted in a professional manner and certainly able to support agriculture productivity. In particular, deep-well groundwater irrigation evidently has bigger water capacity, lesser negative environmental impact and higher efficiency in supplying water to farmlands as it is able to deliver bigger water debit. Therefore, deep-well groundwater irrigation would be an attractive business to venture. In practice, there are very few private irrigation providers and few investors who would want to enter this service business. This is mainly because companies or individuals do not have enough information regarding the regulations in irrigation, knowledge of irrigation technology, market information to explore irrigation as a business venture or do not have access to finance. Investment in deep-well groundwater for instance, requires higher investment compared to shallow-well groundwater. Some farmers attempt to use shallow-well pumps to supply water during dry season because they are relatively cheap and easy to operate compared with deep-well groundwater. Farmers cannot afford to buy and install deep-well groundwater pumps. Since government prioritise water usage for agriculture, investment such as groundwater irrigation is highly recommended.

Poor management of existing irrigation infrastructure by WUAs prevents farmers from receiving good public irrigation services and proper irrigation access.
Government assigned WUAs to manage existing irrigation facilities at the tertiary level, including the canals and groundwater P2AT pumps. WUAs need to understand the correct method in operating the pump, such as how to recharge the fuel, how to activate and deactivate the pumps, or to calculate proper water extraction rate to maintain the water supply and to organise the water intake in tertiary irrigation. WUAs are also required to manage their members and the organisations' financial condition, including how to formulate the appropriate irrigation service fee, and to manage the process for repairs and maintenance. However, many WUAs in EJ are not functioning well and some are already dissolved. Several WUAs implement traditional common practice where they charge irrigation fee based on 'gentlemen agreement' only. Hence, many canals, pumps and other facilities are damaged. This disrupts the water supply and eventually results in shortage of water for farmers. Furthermore, uncertainty in WUAs leadership and organisation's goals also prevents the members to have strong commitment which weakens the quality of the services they ought to provide to farmers.

Farmers do not get enough water because current irrigation infrastructures are insufficient. More than 50% of existing irrigation system are currently damaged and affects to over 730,000 ha of farmland nationwide. This condition is worsened by few new developments

of water resources infrastructure, particularly at the upstream levels. Although infrastructures in the upper level highly influence the water supply that can reach the farmlands, there are limited plans and projects aimed at building new dams, reservoirs, or new canals which supposedly function as water source for primary and secondary irrigation. Existing major infrastructures (dams and reservoirs) in EJ were mainly built in the 1980s or 1990s, and only in 2013 that GOI started to put the development plan of 3 new dams in their agenda (Datin SDA 2013). When the current irrigation infrastructures are insufficient to serve the needs in the agriculture lands, constructing new ones would indeed help to improve the water supply. Similar condition occurs for groundwater infrastructure. Many initiatives do not focus on improving current network. Every year the MoPW allocates only five new P2AT pumps across EJ province. Nonetheless, these programs seemingly are not enough to provide good infrastructure nor to serve the needs of farmlands.

4.2 Weaknesses in Services and Rules / Regulations

The key services weaknesses can be summarised below:

- There are hardly any financial institution that provides financing service for investment in deep-well groundwater irrigation
- Weak organisation and capacity building of WUAs results in the associations' incapability to manage the irrigation infrastructure and tertiary irrigation system.
- Weak government planning and budgeting prevents the development in irrigation infrastructure as priority development area

There are hardly any financial institution that provides financing service for irrigation business, especially for investment in deep-well groundwater irrigation.

The presence of financial institutions will greatly support potential investors, including farmers, lead farmers, individuals or small companies, who would like to enter the irrigation business. This is prominent for deep-well groundwater irrigation that can be more effective in reaching bigger land size in dry season but required high cost. The absence of such service prevents potential investors to enter the irrigation business and acknowledge the potential of the business.

Weak organisation and capacity building of WUAs results in the associations' incapability to manage the irrigation infrastructure and tertiary irrigation system.

Since WUAs are formed and acknowledged by the government, organisational and capacity development of WUAs become the government's responsibility. Basically as part of irrigation programs and initiatives, this should be done by the DPUP since public irrigation system is coordinated by the office, coordinated with the Ministry of Agriculture since irrigation is meant to support good agriculture practices. In practice, there is still very limited trainings or educational activities provided for WUAs, and mostly focus only on surface irrigation. In Jember district for instance, government allocates trainings for surface irrigation WUAs (P3A) only for 16 villages per year although there are more than 260 villages in that district. WUAs' lack of skills and capability result in poor management of the irrigation system and low maintenance of the

infrastructure, which is more apparent in groundwater irrigation where there are many damaged P2AT facilities.

Development of irrigation infrastructure have not yet been the government priority due to weak planning and budgeting

Apparently the development in irrigation infrastructure have not yet been prioritised for many years. Despite its function to support agriculture as the prioritised sector in Indonesia, many irrigation infrastructures are still deficient. Poor assessment on actual needs for irrigation prevents the government to produce proper planning and budgeting on irrigation development. Only recently in 2015 that the GOI started to pay more attention on development in irrigation infrastructure, mostly because of the food crops self-sufficiency initiatives. Nevertheless, limited resources and internal processes in the government would still be the remaining challenges to procure the desired outcomes.

4.3 Gender Issues

As water users, both male and female farmers in drylands face the same difficulty as they are unable to plant crops during the third season or can only plant low yield crops. Many of these farmers leave their lands unplanted and choose to do other things outside agriculture. Male farmers would usually work in a construction side while the females would do household works or involve in traditional market. With the provision of irrigation however, most farmers will need to increase their planting time and change the cropping pattern. The addition of planting time will lead to farmers do more work in the fields. For example, from one to two three times or from two to three times planting per year. The decision to add the planting time (increase cropping intensity) is shared between the men and women (the wives) as it involves with the type of crops that will be planted, source of inputs and the additional workload they need to bear.
If farmers decide to plant crops with higher yield (change the cropping pattern) because water is sufficient, the decision is also shared between men and women. Meanwhile, the decision to buy water for both intentions comes from discussion in the family between men and women as it relates with the amount of money invested on procuring water. If there is initiative to invest as a water provider, some men will ask their wives for their opinion and support.

Based on the observation and discussion with both male and female farmers, no striking dissimilarities between the two in terms of accessing the irrigation. The difference between male and female farmers is mostly found in the management and operational of irrigation, particularly that relates with the pumps, hose and other hefty equipment. Men in this case, take up bigger role as they tend to be more familiar with the technical aspects and able to modify or move some equipment if needed. Taking this further, although men and women have the rights to become member of WUA, rarely that women are listed in the board or management. The limited role and interest of the women in irrigation occurrences suggest their limited involvement in the organisation.

4. Strategy for Change

The strategy is designed to overcome the weaknesses in the current service provision and enabling environment in the market system. This takes the form of (1) identifying the market potential to show the potential of the sector; (2) a vision of change, to envisage how the value

chain or market system would operate if identified problems are resolved; and (3) a set of interventions which can be targeted at specific market actors or groups of market actors in order to drive changes in the market system.

5.1 Market Potential

Non-irrigated wetlands and dry fields are the main potential areas in need for irrigation. Should good irrigation present in these areas, farmers are benefited and able to increase their productivity.

If farmers would like to generate better returns, they must be able to irrigate their crops and generate better yields during dry seasons. Currently there are around 240,000 ha of non-irrigated wetlands and around 1,389,000 ha of dry fields, totalling to around 1,380,000 hectares of potential areas in EJ where can be intervened.

Sourcing from deep-well groundwater, one pump can irrigate up to 40-50 hectares. Calculating the above potential areas, there are around 3,500 potential spots to install deep-well groundwater pumps. If one hectare of farmland is managed by four farmers, there are about 5,200,000 potential farmers in EJ who needs irrigation. In addition to the potential drylands area, there are still many wetlands in EJ which face difficulty obtaining proper irrigation during dry season. A combination of poor water source availability, weather changes and damaged irrigation infrastructure affect to this condition. Considering this, part of the 862.590 ha of wetlands in EJ can also be taken into account as wider market potential.

5.2 Vision of Change

The vision of change for the sector is increased farmers' land productivity during dry season through improved irrigation access and enhanced irrigation system. With the improvement in quality and quantity of irrigation services, both from public and private providers, farmers would easily obtain adequate water supply. This should be supported by the improvement of the nation's irrigation system where there are clear roles, responsibilities and rights of public and private entities within each land coverage or level.

Meanwhile it is envisaged at the service level that farmers have better water supply during dry season through increased availability of irrigation services, higher quality of public irrigation services and improved irrigation infrastructure. Increase availability of irrigation services demonstrate an increase number of private irrigation providers since currently there are very limited number of them. Simultaneously, it is crucial that public irrigation providers improve their service quality, especially in coordinating the water distribution for irrigation and relevant irrigation programs. Further, it is expected that the relevant government put more attention in improving the irrigation infrastructure, both in developing new infrastructure and in maintaining the existing ones.

5.3 Interventions

Based on the analysis, there are at least four interventions in the irrigation sector which would be necessary to help improve farmers' productivity in EJ.

Intervention 1: Promote provision of financing on groundwater irrigation.

At farmers' level, groundwater irrigation scheme exists in some areas in EJ. However, limited expertise and financial capability only allow these farmers to source from shallow-wells using small pumps, which prevents from achieving maximum result. Although deep-well groundwater irrigation is relatively more efficient and environment friendly, many farmers and also other individuals who are interested in becoming irrigation service providers do not have adequate funding to procure the infrastructure (e.g. pumps, installation boxes, pipes, and other equipment) as it may cost more than 60 million rupiahs for one deep-well groundwater pump. Therefore, the availability of financial institutions which can support the funding would greatly benefit to improving access to groundwater irrigation. There is an opportunity to develop this scheme with PT Vasham Kosa Sejahtera where they would provide loans for the service providers (which can include farmers, lead farmers, individuals or even small businesses), to procure deep-well groundwater pump along with the installation and assessment of the water source. Service providers will then supply water to farmers by charging service fee. In turn, service providers will pay back the loan and interest to PT Vasham through instalments. The irrigation financing scheme is a new venture for the potential partner and the service providers since most financing services support agriculture inputs other than irrigation provision. In order to formulate appropriate business model that can work at the villages, the intervention pilot plan will also engage financial consulting firm to conduct the assessment. The location for the pilot plan will be in Ponorogo and will be targeting primarily maize farmers. There is an opportunity to develop deep-well groundwater irrigation in the district because the needs for water is visible and also because of the interest of the partner to enter the area.

Intervention 2: Promote groundwater irrigation service that can be embedded to core agriculture input business.

For companies supplying agriculture inputs such as seeds and fertiliser, entering irrigation service business would strengthen their core business as they can sell the irrigation service combined with other inputs. In a more commercial environment, this can be referred as 'one stop service' or 'one stop shopping' concept. Since groundwater irrigation is the most relevant scheme for supplying to dry areas and during dry season, potential investors are advised to penetrate the groundwater pumping scheme. Companies such as PT Mulya Agro Sarana would be a potential investor suitable for this venture as they can ensure supply of inputs throughout the year. The company already supplies seeds and fertilisers to farmers in EJ and has an interest in expanding to irrigation services to increase their business portfolio. On the other hand, collectors and traders would also want to secure the harvest supply. With the water available in drylands and in dry seasons (throughout the year), farmers can maximise their capacity and produce more harvest to be sold through collectors and traders.

Intervention 3: Facilitate organisational and capacity development for the WUAs.

Since WUAs are under the government authority, this intervention should be in the form of cooperation with the relevant government body, which in this case include the Ministry of Public Works and BBWS. WUAs need to be equipped with proper trainings, coaching and exercises to improve their capability in managing the tertiary irrigation. These should include technical aspects for the operations and maintenance of the current tertiary irrigation infrastructure, as well as economic and financial capability. PRISMA attempts to cooperate with the relevant government in organising proper organisational and capacity building for the WUAs within specific timeframe and with clear goals. The primary target would be the WUAs operating in dry

areas in EJ, namely those who supposedly manage the groundwater infrastructure (P2AT pumps).

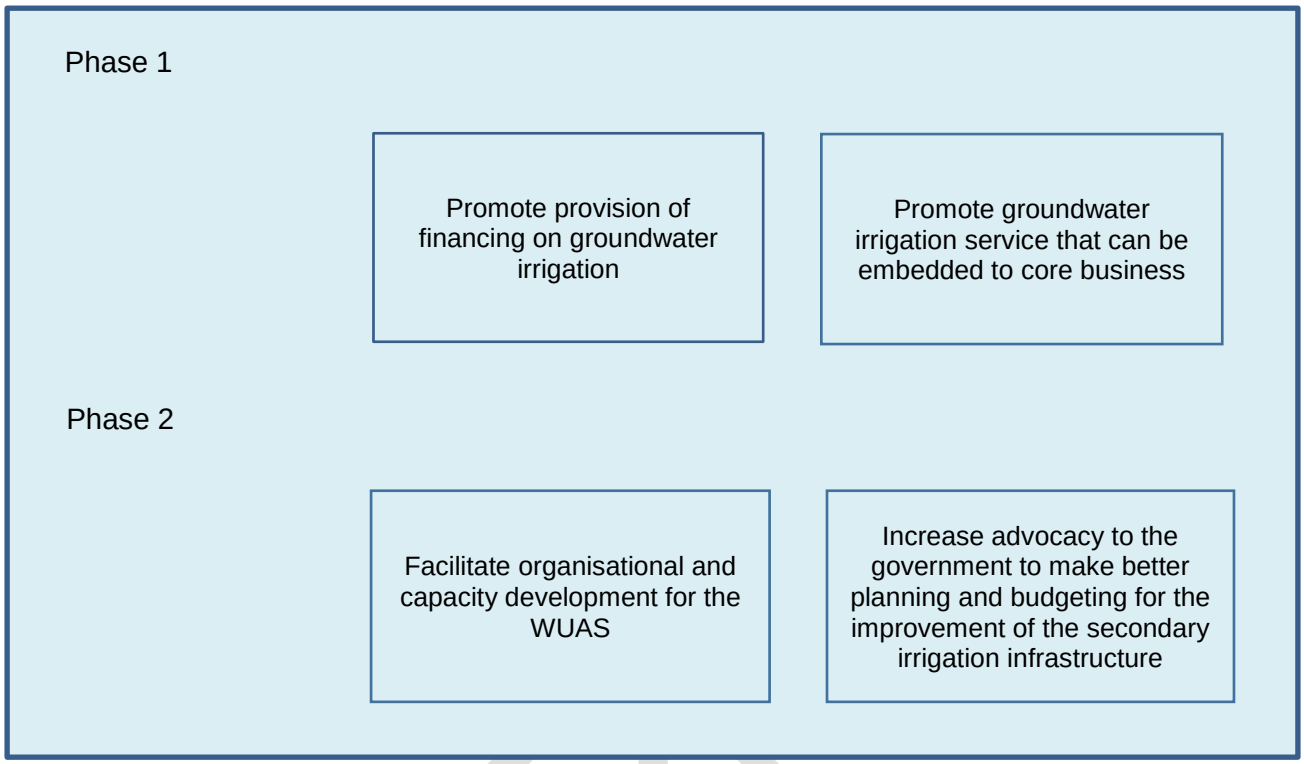
Intervention 4: Increase advocacy to the GOI to make better planning and budgeting for the improvement of the secondary irrigation infrastructure

The secondary irrigation has strong influence on the availability of water for crops production because it supplies to the tertiary irrigation that reaches to the farmlands. As the surface irrigation system is linked interchangeably, when the debit intake/water extraction rate is low from the secondary canals, the tertiary canals will receive less amount of water. The damage in secondary infrastructure and improper arrangement for the water intake operations of the secondary canals would result in inadequate water supply at the farmlands. Since the attempts to improve the irrigation infrastructure are essential parts of the government planning and budgeting, another proposed intervention would be to work together with the relevant government officials (MoPW, DPUP-Province and MoA) to create better planning and budgeting for the enhancement of the secondary irrigation infrastructure. Better planning and budgeting would involve assessment on the current/actual condition of the damaged canals, their system/operations and administration, the actual needs in the field; and primarily, the amount of budget allocation to implement the plan.

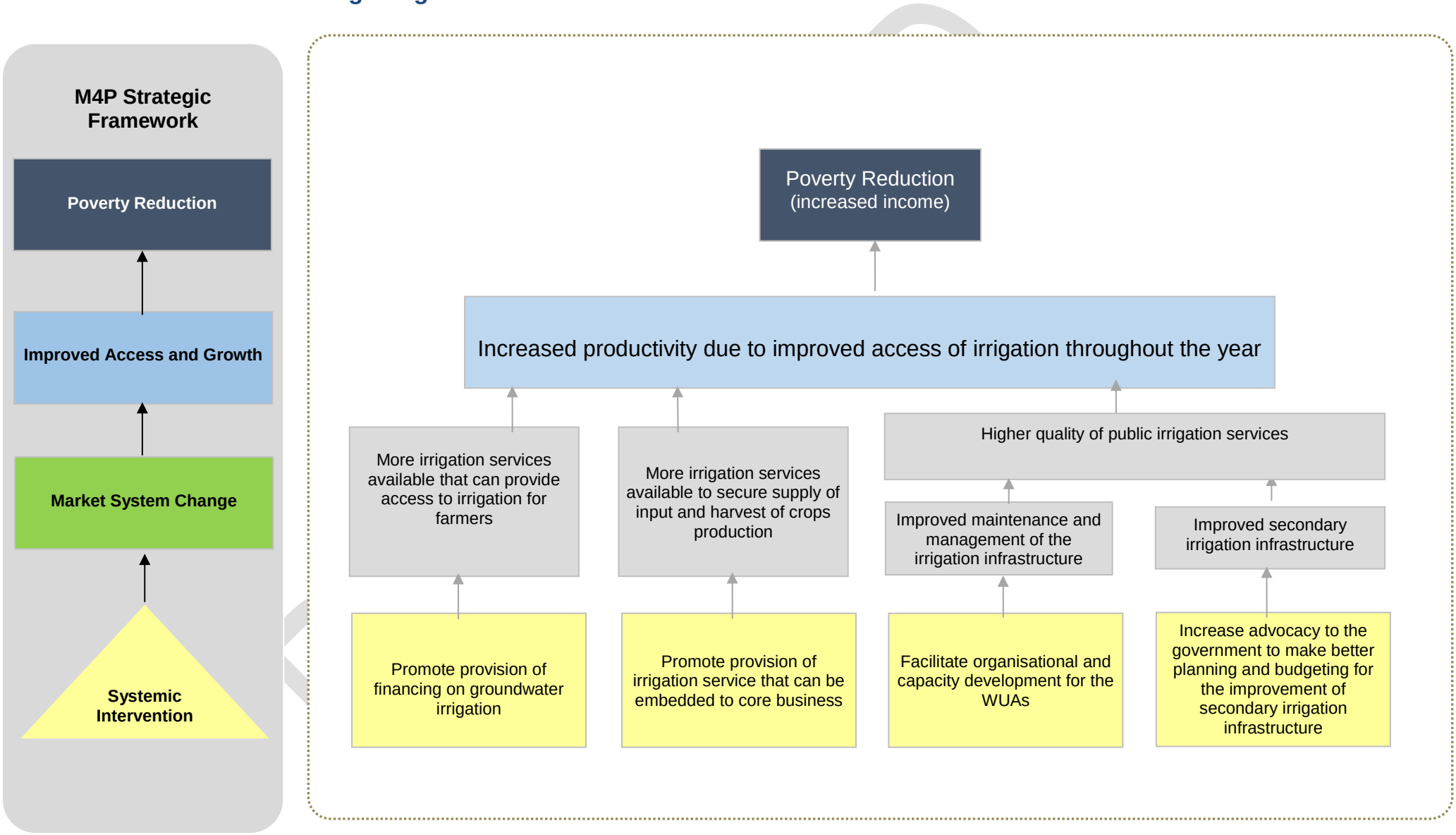
5.4 Sequencing and Prioritization of Interventions

Based on the opportunity and available resources, PRISMA will focus the interventions on the cooperation with the private sector in the first phase, followed by exploring the intervention with the government in the second phase. There are two interventions in the first phase which should be prioritised to gain quick-win for PRISMA, namely promotion of financing for groundwater irrigation and promotion of irrigation as embedded service. Both potential partners (PT Vasham and PT MAS) have shown their interest on the proposed interventions and PRISMA will seek to explore the cooperation at the earliest possible time.

The second phase will include cooperation with the Ministry of Agriculture and Ministry of Public Works (DPUP, BBWS, P2AT) to improve the irrigation infrastructure and strengthen the capacity of the WUAs. It is predicted that the second phase will involve relatively longer process as it deals with wider governmental system and tools.


Phase 1
Promote provision of financing on groundwater irrigation
Promote groundwater irrigation service that can be embedded to core business
Phase 2
Facilitate organisational and capacity development for the WUAS
Increase advocacy to the government to make better planning and budgeting for the improvement of the secondary irrigation infrastructure

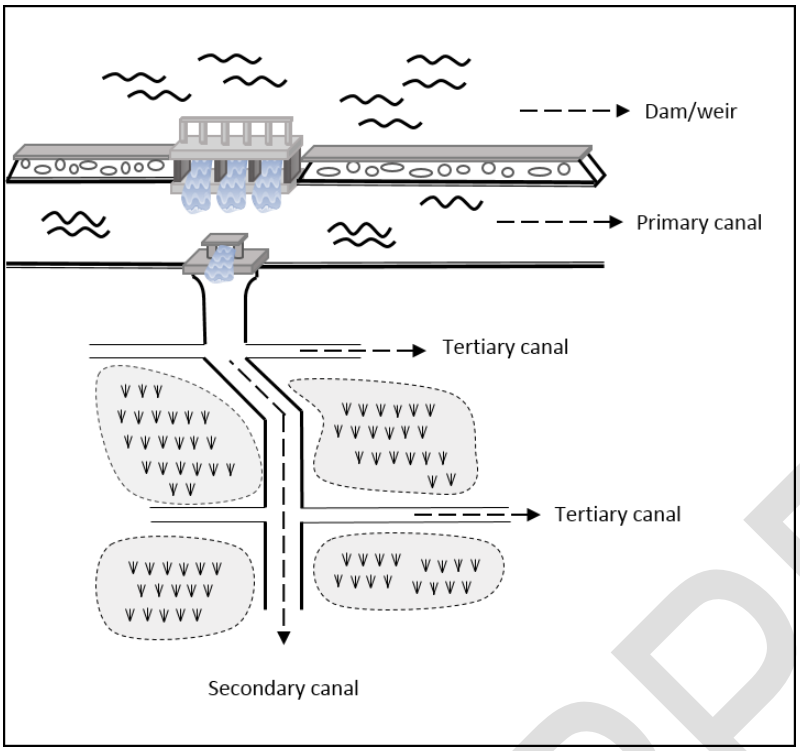
5.5 Sub-sector Vision of Change Logic



Annex 1. Intervention Logic Analysis Framework (ILAF)

(1) Problem / Symptom	(2) Underlying cause	(3) (4) Services and Enabling Environment	(5) Service weaknesses/ underlying causes	(6) Interventions	(7) Service Provider / Partner
Limited number of private irrigation providers which can supply water for crops production in dry season	Lack of access to irrigation service business due to financial incapability of the potential investor	Financing services	No private institution that provides financing support for the irrigation service business	INT 1: Promote provision of financing on groundwater irrigation	• Financing agency • Irrigation service providers • Local investor • WUAs/farmers
	Lack of information regarding opportunity to expand the irrigation business	Information service Irrigation technology	Limited information regarding business profitability of the irrigation business to support existing business Efficient/suitable technology is not widely known in the market	INT 2: Promote irrigation service that can be embedded to the core business	• Private investors (agriculture companies) • Input suppliers • Collectors, traders
Lack of irrigation infrastructure	Poor management of existing irrigation infrastructure by WUAs	Organisational and capacity development	Very few capacity building and organisational strengthening activities provided by the government for the WUAs	INT 3: Facilitate organisational and capacity development for the WUAs	• Ministry of Public Works Water Resources - BBWS • WUAs
	Development in irrigation infrastructure has not been put as the government's priority	Government planning and budgeting	Weak planning and budgeting, poor assessment on actual irrigation infrastructure and needs for irrigation improvement	INT 4: Increase advocacy to the government to make better planning and budgeting for the improvement of secondary irrigation infrastructure	• Ministry of Public Works Water Resources • Provincial Office Irrigation • Ministry of Agriculture • WUAs

Annex 2. Irrigation System Illustration



Annex 3. Land Type and Size - East Java & Indonesia

Land Type	INA – 2012	INA – 2013	EJ - 2012	EJ - 2013
Wetland	8.132.346	8.112.103	1.152.875	1.102.863
- Irrigated Wetland	4.417.582	4.819.525	910.533	862.590
- Non Irrigated Wetland	3.174.764	3.292.578	242.342	240.273
Dry Field / Garden	11.947.956	11.876.881	1.129.772	1.141.452
Shifting Cultivation	5.262.030	5.272.895	37.800	37.520
Temporarily Unused Land	14.245.408	14.213.815	10.474	15.270
Total	39.587.750	39.475.694	2.330.921	2.297.105

Annex 4. People Interviewed

No.	Date	Location	Name	Represent	Contact Details
1	2-Feb-2015	Surabaya	Doto (Toto)	P2AT BBWS Brantas	0811 341 3362
2	3-Feb-2015	Malang	Dadang	Balai Penelitian Teknologi Pertanian	0812 5211279
3	5-Feb-2015	Patalan, Probolinggo	Hermanto	Irrigation provider (private)	0852 336472034
4	10-Feb-2015	Surabaya	Fauzi	Dinas PU Pengairan Jawa Timur - Kasie Penyusunan Program	0812 28048676
5	11-Feb-2015	Surabaya	Ardi	Java Surya Teknik, Pump distributor	0899 3372119
6	4-Mar-2015	Jember	Jazuli	Komisi Irigasi Jember	0853 31155554
7	4-Mar-2015	Wonosari, Jember	Eko	Ketua GHIPPA, anggota Komisi Irigasi	0813 32030373
8	6-Mar-2015	Situbondo	Haji Hasan	Ketua GHIPPA Tanjung Pecinan, Situbondo	0812 32036555
9	16-Mar-2015	Surabaya	Harry	BBWS Brantas OP 1	0813 34629744
10	30-Mar-2015	Sumberkarang, Mojokerto	Wawan	Head of Sumberkarang village	0813 32785101
11	30-Mar-2015	Dlanggu, Mojokerto	Nunuk Djatmiko	SKPD Kecamatan Dlanggu, Mojokerto	(0321) 510176
12	31-Mar-2015	Malang	Didit Priambodo	Perum Jasa Tirta I	(0341) 551971 ext. 112
13	31-Mar-2015	Gempol	Ferry	Balai Besar Wilayah Sungai Brantas OP 2 (groundwater, city rivers, heavy machineries)	(0343) 852033
14	14-Apr-2015	Pasuruan	Moh. Saiful Fuad	Dinas PU Pengairan Kabupaten Pasuruan	0813 30669142
15	15-Apr-2015	Surabaya	Ninik Purwandari	Dinas PU Pengairan Provinsi Jawa Timur)	0812 3108259
16	15-Apr-2015	Surabaya	Ahmad Efendi	Dinas PU Pengairan Provinsi Jawa Timur - Staf Operasional dan Pemeliharaan	0819 73726294
17	15-Apr-2015	Surabaya	Didik Sugiarto	Balai Besar Wilayah Sungai Brantas	0812 3517550
18	15-Apr-2015	Surabaya	Sri Sejati	Balai Besar Wilayah Sungai Brantas	0819 38213600
19	15-Apr-2015	Surabaya	Sumarmanto	Dinas Pertanian Provinsi Jawa Timur	0813 33608879

20	15-Apr-2015	Surabaya	Ahin Solihin DM	Dinas Pertanian Provinsi Jawa Timur	0813 94654111
21	15-Apr-2015	Surabaya	Djoko M	Dinas ESDM Provinsi Jawa Timur	0813 51465529
22	15-Apr-2015	Surabaya	Darmawan	Dinas ESDM Provinsi Jawa Timur	0812 3540542
23	20-Apr-2015	Surabaya	Indro	Dinas PU Pengairan Provinsi Jawa Timur - Kabid Sarana & Prasarana	0812 94549777
24	20-Apr-2015	Surabaya	Penny	Dinas PU Pengairan Provinsi Jawa Timur - Kasubid Irigasi	0821 39858551
25	22-Apr-2015	Mlorah, Nganjuk	Edi	Farmers association (Poktan)	0852 31738106
26	22-Apr-2015	Mlorah, Nganjuk	Purwanto	Farmer, groundwater pump owner	0813 35709809
27	23-Apr-2015	Dlanggu, Mojokerto	Suwanto	Dinas PU Pengairan Kecamatan Dlanggu - Unit Pelaksana Teknis Tangunan	(0321) 510752
28	23-Apr-2015	Djrambe, Mojokerto	Satiman	Farmer	
29	23-Apr-2015	Sumbersono, Mojokerto	Nasikan	Farmer	
30	23-Apr-2015	Randugenengan, Mojokerto	Kasman	Farmer	
31	23-Apr-2015	Sumbersono, Mojokerto	Giso	Farmer	
32	24-Apr-2015	Jember	Taufic	Owner of Persada Tani (kiosk)	0812 3481275
33	24-Apr-2015	Jember	Wenny	Dinas PU Pengairan Kabupaten Jember	0813 58737373
34	24-Apr-2015	Sukorambi, Jember	Mufid	P2AT (Technical Assitance - pumps and machineries)	0812 249797900
35	24-Apr-2015	Jenggawah, Jember	Haji Mustahim	Water User Associations (HIPPA)	0852 57238129
36	24-Apr-2015	Jenggawah, Jember	Jatimulyo	Farmer	
37	7-May-2015	Jetis, Ponorogo	Paryono Fadillah	Monsanto - production	0812 2719 252
38	7-May-2015	Jetis, Ponorogo	Heri	Lead farmers - Monsanto	0853 27850 669
39	8-May-2015	Sampung, Ponorogo	Suyatno	Farmers association (Poktan)	0813 67439996
40	8-May-2015	Sampung, Ponorogo	Katimun	Farmer	
41	8-May-2015	Sampung, Ponorogo	Jamin	Farmer/deep-well pump owner	

42	8-May-2015	Sampung, Ponorogo	Slamet	Farmer/deep-well pump owner	
43	1-Jul-2015	Ponorogo	Gianto	Lead farmer - Monsanto	0811 294479
44	1-Jul-2015	Dungulan, Ponorogo	Parni	Farmer	
45	1-Jul-2015	Duri, Ponorogo	Marni	Farmer	
46	2-Jul-2015	Nglayang, Ponorogo	Diyatmoko	Farmer	

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Ministry of Agriculture Website

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