CO-INVESTMENT

for sustainable production landscape in the downstream Rejoso Watershed

World Agroforestry (ICRAF)

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Editors:
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EXECUTIVE SUMMARY

Located in Pasuruan District, East Java, the Rejoso Watershed is one of critical catchment areas for Java island. Water is a vital natural resource for Pasuruan, with many developmental sectors depending on these resources, including a national water supply project, Umbulan, and a number of large export-orientated industries. In addition, as in other urban-rural areas on Java, Pasuruan experiences challenges related to increasingly intense competition for land for agriculture, settlements, and industrial purposes.

The Rejoso Kita project involved a research pilot to test specific methodologies to conserve ecosystem services, to strengthen the local economy and livelihoods, and to mitigate the impacts of environmental degradation in the Rejoso Watershed. In particular, Rejoso Kita Phase 2 facilitated activities and initiatives: i) to conduct pilots to test, assess, and demonstrate the potential of sustainable paddy cultivation (SPC) techniques and methodologies to improve the production of rice in terms of both quality and quantity, including through the establishment of demonstration plots for this purpose; ii) to conduct pilots to test, assess and demonstrate the potential of appropriately-designed, community-managed artesian wells to improve the efficiency of water usage in the agricultural sector, with particular emphasis on facilitating and assessing behavioral changes, particularly among farmer groups involved in the construction, maintenance, management, monitoring and evaluation of these wells; iii) to revitalize the Pasuruan District multistakeholder watershed to facilitate the involvement of a wide range of stakeholders in replicating, upscaling and mainstreaming of the piloted initiatives to amplify the positive economic and environmental impacts of the project on a wider scale.

The book is organized as follows: a general introduction (Chapter 1); the action research site description and its context (Chapter 2); project workflow and processes, including the initial engagement process in the downstream villages (Chapter 3); landscape typology development and action research pilots to facilitate the adoption and uptake of sustainable paddy cultivation (Chapter 4-5), water-efficient management design and construction (Chapter 6); and the revitalization of watershed forums (FDP) through a multistakeholder partnership platform in Pasuruan (Chapter 7). Finally, Chapter 8-9 describes the related knowledge management processes and various communication product published and channelled to target audiences, with lessons learned recommendations for future works.

World Agroforestry (ICRAF) has coordinated Rejoso Kita Phase 2 through engagement with a wide range of stakeholders, including local government agencies, farmer groups, and farmer champions. The project received significant support from the Danone Ecosystem Funds, Danone-AQUA, and the Rabo Foundation, with these entities playing various roles is granted providers, ecosystem service buyers, and impact investors. These entities have played a major role in enabling the implementation of the project and facilitating its upscaling to achieve wider impacts within and beyond the district.

Rejoso Kita Phase 2 Fact Figures:

- The dominant form of land cover in the two downstream subdistricts in which the pilots were conducted (Gondang Wetan and Winongan) are **rice fields (3,199 ha; 45%)**; **agroforestry complex (1378 ha; 20%)** and **settlement (910 ha; 13%)**. In total, the two subdistricts cover **7,033 hectares.**
- The action research sites in the two subdistricts were selected based on the following parameters: **number of the artesian well (high); area of paddy fields (high); number of low-income families (high); and number of families with a member of the family as agriculture labour (high)**.
- **The eleven villages** in which pilots were conducted are **Wonosari, Wonojati, Tenggilis Rejo, Kebon Candi, Brambang and Bayeman (Gondang Wetan) and Gading, Mendalan, Penataan, Menyarik, and Lebak (Winongan)**.

- An analysis of the performance of the demonstration plots relative to that of areas and using conventional means shows that the innovations potentially produced the following benefits:
  - Increased productivity (32%);
  - Increased profitability per hectare (123%);
  - Reduced greenhouse gases (-36%);
  - Reduced use of water, particularly rice produced (-15%)
- Ninety-four smallholder farmers participated in individually-implemented SPC on a total area of land covering 44.3 ha.
- 110 smallholder farmers engaged in 'tanam serempak' (collective planting with harmonized planting calendar in contiguous block) on an area of land covering 35.9 ha.

- Facilitation was provided to enable farmers to access premium markets for high-quality rice, potentially generating higher sales prices. Orisa is a brand of healthy rice produced in partnership between AQUA and HIPOCI and op-erated by Karya Masyarakat Mandiri.

- At the end of the project, the active farmer were able to manage their group cash flows independently and to initiate an agriculture tool rental business.
- At least 25 farmers participated in the Koperasi Tekun saving-and-loan cooperative, supported by the Rabo Foundation.

- The project facilitated the construction of four new appropriately-designed, community-managed artesian wells and the closure of four old, suboptimal, inefficient wells.
- At least sixty-eight farmers gained the necessary skills to effectively monitor water discharges from the newly constructed wells and irrigation channels.
- By June 2022, the participatory water use monitoring processes involving the farmer groups resulted in a water efficiency level of 14.3 l/s in estimation.

- Based on the precipitation index and SPAM distribution, all villages in the two sub-districts have potential access to groundwater, although some experience shortages due to inefficient distribution.
- Water demand for domestic uses (60%) is much higher than water demand for agricultural uses (1%).
- The proportion of groundwater effectively used amounts to only 14% of the total flow of current artesian wells, indicating a high inefficiency.

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CHAPTER 1
INTRODUCTION

Beria Leimona, Ni'matul Khasanah, Aunul Fauzi

To ensure the sustainability of Indonesia's agricultural production, there is an urgent need to transition towards regenerative, multifunctional landscapes [1-3]. With agricultural land becoming increasingly scarce due to population pressures and other factors, current agricultural practices contribute to environmental degradation, including climate change, deforestation, and losses to biodiversity and ecosystem services. If Indonesia does not transform its agricultural practices and production landscapes, it will not achieve its national targets for sustainable development goals in the coming decades.

One means of facilitating a meaningful transformation of the agricultural sector and its production landscapes to enable them to contribute positively to livelihoods and ecosystem services is by piloting sustainable, regenerative agricultural practices. Furthermore, to ensure the widespread adoption and uptake of these practices by smallholder farmers, subnational government agencies must promote and socialise the results of these pilots.

The Rejoso Kita project involves a research pilot to test specific methodologies to conserve ecosystem services, strengthen the local economy and livelihoods, and mitigate environmental degradation impacts in the Rejoso Watershed [4, 5]. Located in Pasuruan District, East Java province, the Rejoso Watershed is a critical catchment area for Java, with agriculture as the most important source of livelihood for its communities. Water is a vital natural resource for Pasuruan, with many developmental sectors depending on these resources, including a national water supply project, Umbulan, and a number of large export-orientated industries. In addition, as in other urban-rural areas on Java, Pasuruan experiences challenges related to increasingly intense competition for land for agriculture, settlements, and industrial purposes.

The Provincial Planning Unit of East Java has stated that water debits from the Umbulan Spring have declined since 2007. The primary reason for this decline is the uncontrolled groundwater extraction from deep artesian wells. Consequently, the surface level of the Sungai Rejoso (Rejoso River) has also declined, causing two main problems. Firstly, the reduction in the surface water implies that it has less carrying capacity and therefore reduced capacity to neutralise waste, thus resulting in a deterioration in water quality. Secondly, given that rivers constitute one of the most important sources of water for a

wide range of uses, the water available for these uses has also declined. This has potentially negative effects for a number of sectors in Pasuruan, most particularly the agricultural sector, which is dominated by smallholder farmers and artisanal fisheries. In addition, as with many other urban-rural areas on Java, Pasuruan District faces a high level of competition for land, with competing interests for agriculture, settlements, and a range of industrial and other activities, including tourism.

Indonesian Law No. 17, 2019, provides a formal guideline for the prioritisation of the use of groundwater, listing these priorities in descending order as follows: communal primary needs, artisanal agriculture, drinking water supply, public business, and finally private industrial business. Under this law, the government is obliged to formulate a water resource budget for each of these usages. To ensure the availability of water supplies to meet community needs, the government implemented its policies on the basis of the concept of "One basin, multiple management," which refers to the application of a multistakeholder, multisectoral approach to the utilisation and management of groundwater.

The provincial government of East Java has stated that its efforts to ensure the sustainability of the water discharge from Umbulan is maintained through: (1) planting tree stands in the recharge area, which covers approximately 100 km^2; (2) applying a system of community artesian well control in the released area; (3) the construction of approximately 1,000 (one thousand) infiltration wells; and (4) controlling rock mining in the recharge area. Efforts to mitigate the decline in the discharge level of the Rejoso River in the middle and downstream areas and to prevent excessive brackishness to ensure the suitability of water supplies for agricultural purposes are implemented through measures to increase the Rejoso River water discharge levels by: (1) normalising irrigation drains; (2) natural wasters (Gesing, Segoropuro, Prodo); and (3) normalising tributaries (Plumbon River, Kasuran River, Lingkung River, Kambingan River and Betotot River). Mitigation efforts to increase the water discharge in the middle section of the Rejoso River involve the construction of two rainwater reservoirs to store water during the rainy season in Cukurguling Village (Cukurguling Embung 1 and Cukurguling 2) and the construction of a weir in Sumbermade River with this weir equipped with a supplementary channel.

The impact of the degradation of water quality resulting from the decline in discharge levels is mitigated by: (1) providing a communal wastewater treatment Plant (IPAL) and an associated sewerage network; (2) providing integrated waste processing sites (TPST) at densely populated locations along the Rejoso River; (3) intensified law-enforcement to reduce pollution from industrial waste resulting from the operations of business actors who dispose of liquid waste into the Rejoso River. Socialization efforts are conducted to increase the awareness and understanding of community leaders,

religious leaders, village government officials, non-governmental organizations, sub-district forum on matters related to water source conservation, both in recharge areas and released areas.

Despite these efforts, hydrological problems persist, with the interventions insufficient to address the complex issues affecting the Rejoso Watershed. This is partly due to the fact that management of these interventions are not integrated under a single unit or agency at either the provincial or district levels, with the problem compounded by a lack of data and information.

Supported by the Danone Ecosystem Fund and Rabo Foundation, World Agroforestry (ICRAF) is coordinating the Rejoso Kita project throughout its two phases, Phase 1 (2016–2019) and Phase 2 (2019-2022). During Phase 1, the project focused on payment schemes for ecosystem services (PES) in the up- and midstream areas of the watershed to preserve buffering functions and to secure adequate water supplies. This phase involved multidisciplinary research outputs, including the characterization of smallholder farming systems, local livelihood assessments, ecosystem service measurements, and contract values of PES, which informed the PES design, pilot, monitoring, and evaluation. Phase 2 addressed issues related to sustainable, regenerative agriculture for lowland paddy cultivation, the rationalisation of water consumption, and measures to reduce the negative impacts of agricultural practices. Thus, Phases 1 and 2 of the Rejoso Kita project cover potential issues related to ecosystem services within the production landscape involving smallholder farmers, and associated recommendations for integrated watershed solutions in up, mid, and downstream areas of the watershed.

This book describes the processes involved in piloting systems to engage farmers in sustainable paddy cultivation and the management of appropriately constructed artesian wells under Phase 2 of the Rejoso Kita project, together with lessons learned from these processes. The book is organised as follows: a presentation of the context and initial engagement process in the downstream villages (Chapter 2); methodologies applied in developing the overall action research of Rejoso Kita Phase 2 (Chapter 3); landscape typology development and action research pilots to facilitate the adoption and uptake of sustainable paddy cultivation (Chapter 4–5), water-efficient management design and construction (Chapter 6); and the revitalisation of watershed forums (FDP) through a multistakeholder partnership platform in Pasuruan (Chapter 7); and related knowledge management processes and various communication product published and channelled to target audiences (Chapter 8). Finally, Chapter 9 provides recommendations to replicate and upscale the integrated watershed and water resource management.

1.1 Pasuruan groundwater basin and river region

At present, the management of water recharge and discharge areas is conducted according to one of two principal management models, these being (1) water basin-based management, implemented under the rubric One Basin One Management, in which responsibility for the management of water basin located in more than one administrative areas falls under the mandate of a single agency, which may be either a provincial or national agency; and (2) river area-based management, in which responsibility for the management of a single water basin may fall under the mandate of more than one government or authority, depending on the location of the water basin and its components. In this case, a higher authority, such as a provincial-level agency, may exercise authority in more than one water basin.

In this context, management refers to program planning, implementation, and budget allocation, not only for water utilization, but also for conservation.

With regard to issues related to conservation, the challenges related to applying the river-area management model may include the need for extensive and prolonged coordination efforts between the sectors involved, with conflicts of interest related to water extraction, particularly related to the prioritisation of water use and allocation, and to assigning specific responsibilities amongst the various agencies involved. While these efforts are being conducted, water extraction and conservation activities may continue as usual, even in the absence of any final agreement between the sectoral actors involved, with a deleterious impact on the water basins and watersheds in question.

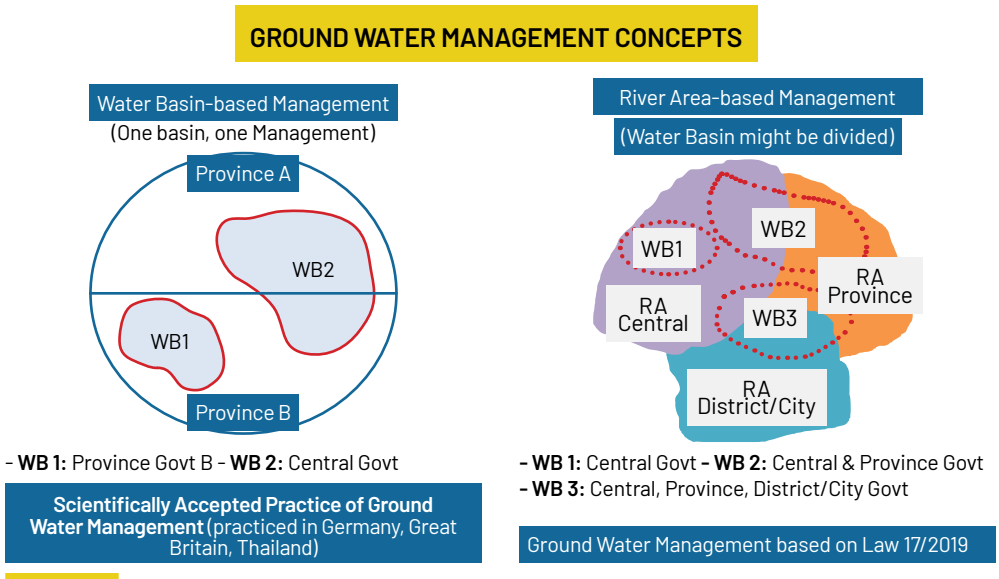
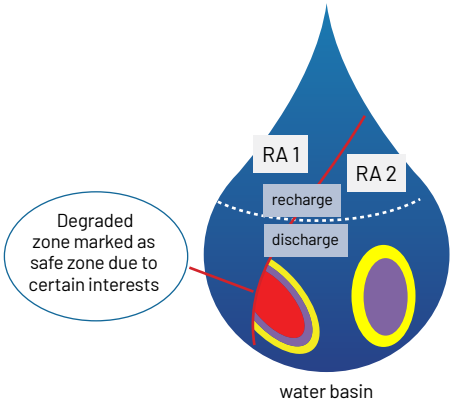


Figure 1. The concept of groundwater management in Indonesia.

Source: Resource Center for Groundwater and Environmental Geology, Geological Agency of the Ministry of Energy and Mineral Resources

Water Basin Conservation Zone based on River Area

Chapter 11 (e) and Chapter 14 (e) Designation of groundwater conservation zone on water basin in river area
Divided water basin: Conservation map produced by related agencies (central and local government)



Issues in groundwater conservation zone:

- Coordination (1 WB managed by several RA) -> need cross RA coordination, longer time
- Conflict of interest (water extraction from groundwater protection zone may be limited) -> RA with certain interests will not tolerate degraded zone, recharge area, etc.

Figure 2. Conservation zone management of groundwater basin according to the Indonesian regulation.

Source: Resource Center for Groundwater and Environmental Geology, Geological Agency of the Ministry of Energy and Mineral Resources.

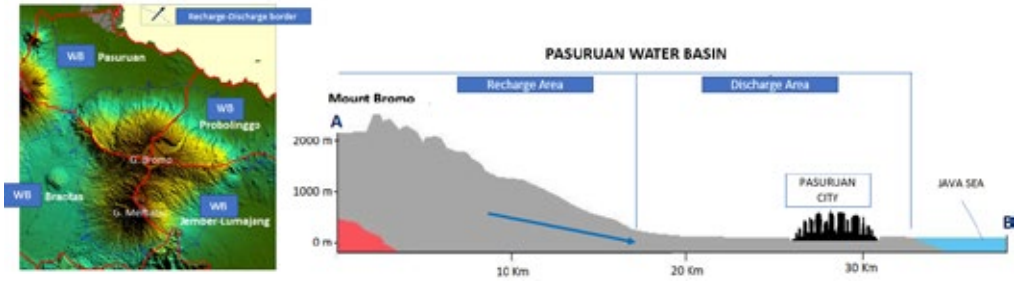


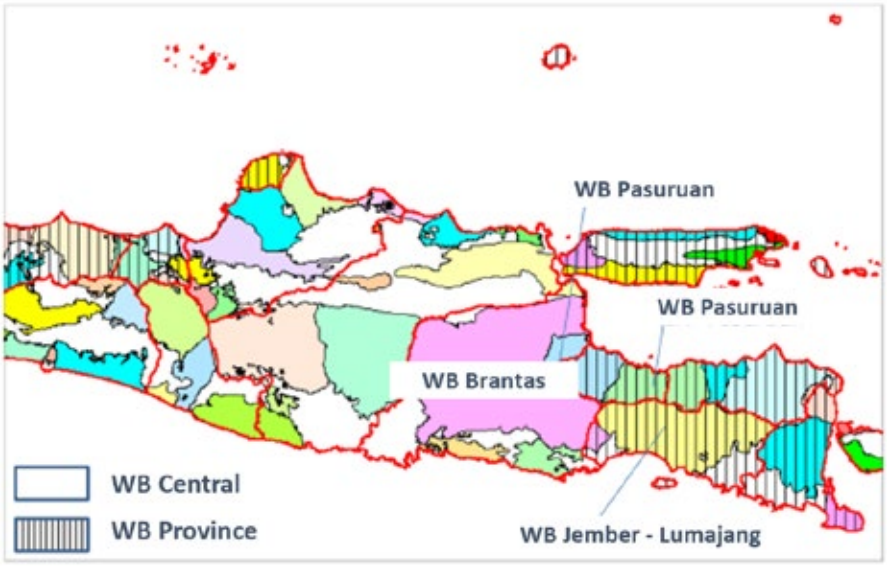
Figure 3. Four groundwater basins of the Mount Bromo Region in East Java.

Source: Resource Center for Groundwater and Environmental Geology, Geological Agency of the Ministry of Energy and Mineral Resources

Within East Java, the Mount Bromo region is divided by four groundwater basins: Brantas, Pasuruan, Jember-Lumajang and Probolinggo.

According to Law No. 17, 2019, on Water Resources, responsibility for the Pasuruan Water Basin falls under the mandate of the East Java Provincial Government and the National Government. However, since the water basin recharge and discharge areas are administratively located within Pasuruan District, matters related to its usage and conservation must include wide range of actors at the local, provincial, and national levels, who must cooperate in implementing an integrated watershed management strategy.

WB vs RA in East Java



Authorities based on Law 17/2019	**WB Brantas:** Central & Province **WB Pasuruan:** Central & Province **WB Jember-Lumajang:** Province

Figure 4. Water Basin managed by the Central and Provincial Government located in East Java Province.

Source: Resource Center for Groundwater and Environmental Geology, Geological Agency of the Ministry of Energy and Mineral Resources

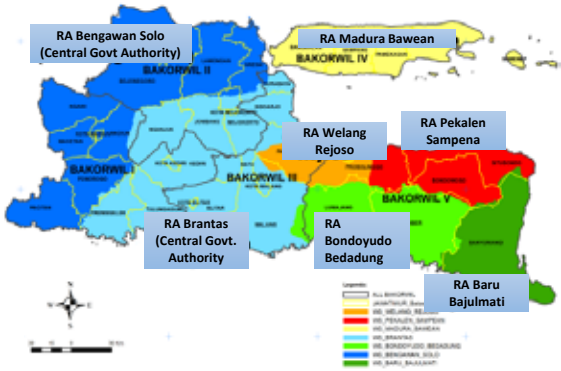
Conserving the water basin with its huge groundwater potential, is strategically extremely important for ensuring its optimal and sustainable contribution to the provincial water balance, particularly given the impact of anthropogenic activities, land use change and natural resources exploitation.

With reference to its 2019-2024 Water Resources Management Plan, the Public Works and Housing Office of East Java Province states that there is an annual deficit of 2,72 billion cubic meters of water in the province, calculated by subtracting water needs (22,22 billion cubic meters) from water availability (19,48 billion cubic meters). It remains challenging for the provincial government to tap potential water resources (53,61 billion cubic meters from rainfall, rivers, lakes, springs, and groundwater) by improving and revitalising water supply, agriculture irrigation systems (building and maintenance of canals), flood disaster mitigation, hydrology and water quality assessment, and water resource management institutionalization and supervision.

MAP OF RIVER AREA AND WATER RESOURCES POTENTIAL

Yearly Water Balance (billion/m³/year)
Water resource potential: 53.61
Availability: 19.48
Water need: 22.20

Deficit: 2.72



East Java area **: 47,113 km²**
2,5% of Indonesia

Irrigates rice fields **: 934,683 ha**
12.8% of Indonesia
- Central government : 289,509 ha
- Province government : 164,823 ha
- District/city government : 480,352 ha

PERMEN PUPR No. 14/PRT/M/2015
on Criteria and Designation of Irrigation Area Status

Number of river areas **: 7 RA**
- 2 RA under central govt. authority
- 5 RA under central govt. authority

Yearly rainfall **: 1,800 mm**

PERMEN PUPR No. 04/PRT/M/2015
on Criteria and Designation of River Area

Figure 5. Map of river area and potential water resources.

Source: East Java Province Public Works Agency – Water Resources.

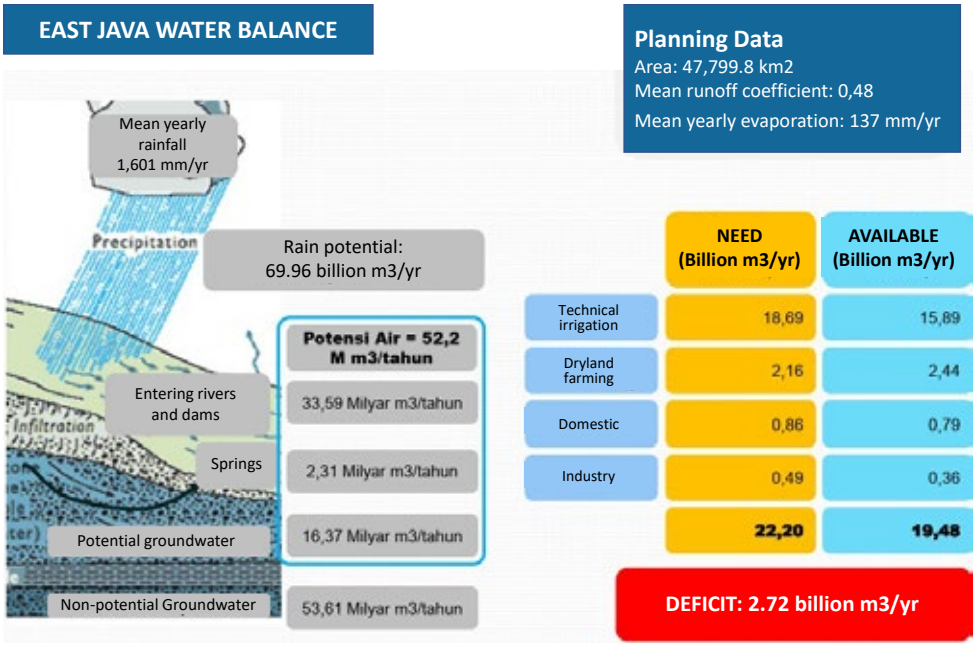


Figure 6. Water balance in East Java.

Source: East Java Province Public Works Agency – Water Resources

The Provincial Planning Unit of East Java has stated that within the province, there is a need for approximately 22.20 billion m^3 of water annually.

According to water balance data made available by the East Java Provincial Office for Public Works and Housing, the water availability status in all of the districts and cities within the Bromo Tengger Semeru area indicates a surplus, meaning that the use of water for domestic, agricultural and industrial purposes is lower than the potential availability of water resources.

In Pasuruan District and Pasuruan City, where the Pasuruan Water Basin is located, potential water resources amount to more than 4.5 billion cubic meters per year, while the volume of water actually used amounts to 837,41 million cubic meters, or 17.8 percent of the total available. In terms of clean water resource carrying capacity, Pasuruan District is categorised as moderate, while Pasuruan City is categorised as very low.

Table 1. Water balance in numbers

Annual precipitation	1601 mm/year
Unit (billion m^3/year)	
Volume of precipitation	69.96
Potential water availability	52.2
Entering river and dam	33.59
Spring	2.31
Groundwater potential	16.37
Unavailable groundwater	53.61

Source: East Java Province Public Works Agency – Water Resources

Table 2. Water balance of Bromo, Tengger, Semeru Area.

Irrigation data (million m^3/year)

No	District/City	Potential	Need for Agriculture, Domestic, Industry	Note
1	Probolinggo District	1,017.03	719.28	Surplus
2	Probolinggo City	670.58	71.27	Surplus
3	Lumajang District	1,757,00	1,515,28	Surplus
4	Pasuruan District	3,065,57	695.78	Surplus
5	Pasuruan City	1,641,89	141,53	Surplus

Source: East Java Province Public Works Agency – Water Resources.

Table 3. Water balance of Bromo, Tengger, Semeru Area.

Clean water carrying in KLHS RPJMD 2019-2024 (million m^3/year)

No	District/City	Rain Water Availability	Domestic Need	Clean Water Carrying Capacity
1	Probolinggo District	87.01	3,31	Average
2	Probolinggo City	4,32	0,56	Very Low
3	Lumajang District	126,17	2,97	Very High
4	Pasuruan District	52,55	4,59	Average
5	Pasuruan City	2,11	0,59	Very Low

Source: East Java Province Public Works Agency – Water Resources.

To address the issues related to the management of the watershed and river basin, the East Java Provincial Planning Agency formulated the fourth mission on the Regional Medium Term Development Plan (RPJMD) for 2019-2024, which contains the following provision: To implement regional development based on community service spirit, environmentally friendly to ensure harmony of ecological space, social space, economic space, and cultural space.

The JATIM HARMONI approach for the implementation of the fourth mission is based on a recognition of the concepts of sustainable development, area-based development, and watershed-based development of forest areas and environments. The indicators of achievement include environmental quality index, water quality index, air quality index, and land cover quality index.

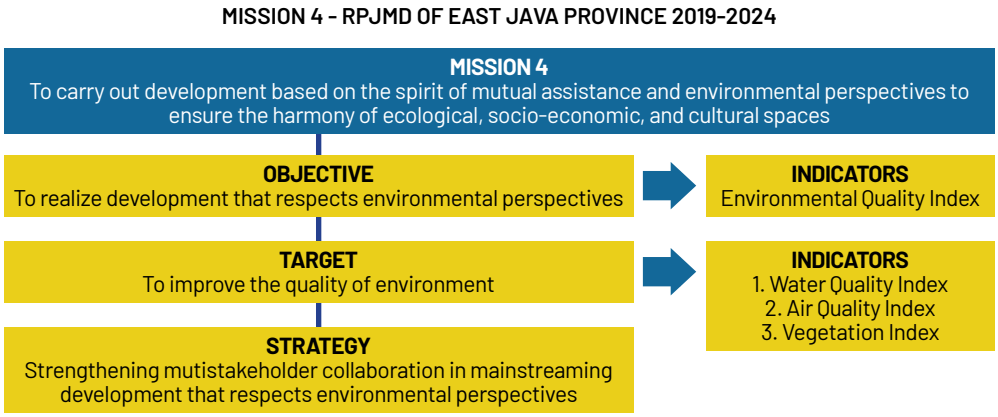


Figure 7. Mission 4 of the Regional Development Plan of East Java Province 2019-2024.

Source: Regional Development Planning Agency of East Java Province.

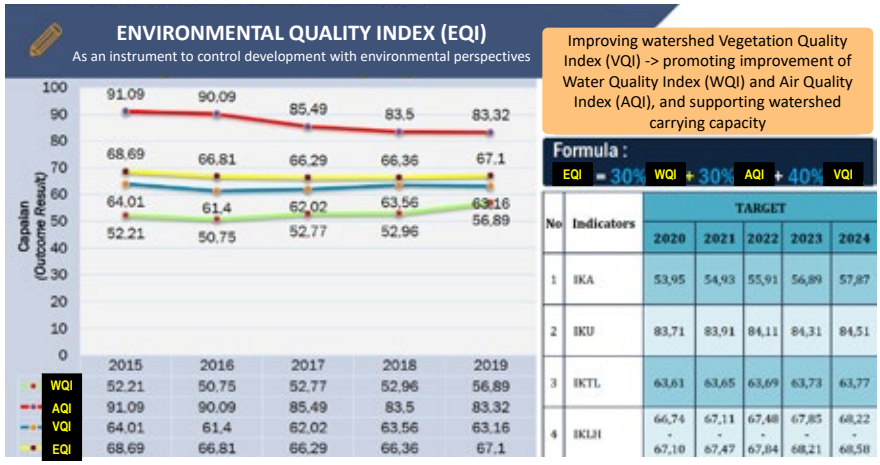


Figure 8. Environmental Quality Index of East Java Province (2015-2019).

Source: Regional Development Planning Agency of East Java Province

1.1.1 A water-rich district with many hydrological-related problems

The East Java Provincial Planning Agency has outlined the following measures to anticipate water deficits in technical irrigation areas (PerMenPUPR 14/PRT/M/2015), with these efforts involving synergies with the central government, regency/city governments, and related stakeholders such as Water User Farmers Association (HIPPA/Gabungan HIPPA/Induk HIPPA) and other water users coordinated by the Irrigation Commission & River Basin Water Resources Management Coordination Team (TKPSDA WS):

- Optimizing the implementation of the Planting Plan by developing synergies with the Water Allocation Plan: for each irrigation area, certain plant types (rice, sugarcane, annual crops, and others) are deemed suitable, with the size of the planting area to be adjusted according to the availability of water for three planting seasons and thus to minimize unplanted rice fields (bero) while maintaining soil nutrients.
- Optimizing efforts to monitor water extraction to comply with the water allocation plan.
- Monitoring, maintenance, and rehabilitation of irrigation networks to reduce the water loss coefficient in irrigation canals and structures.
- Accelerating the construction of dams/reservoirs and their irrigation networks that are included in the National Strategic Project (PSN) implemented by the Central Government.

1.2 Rejoso Watershed and its landscape characteristics

The Rejoso Watershed is located in the foothills of Mount Bromo and covers 16-sub districts, 13 of which are in the eastern section of Pasuruan district, and three of which fall within the boundaries of Pasuruan City, East Java (see Figure 9). The watershed acts as a source of clean water for Pasuruan District, surrounding districts, and cities including Sidoarjo and Surabaya, the metropolitan capital of East Java. Umbulan Spring - a spring with the one of the highest water debits in Java - is located in the midstream area of the Rejoso Watershed.

The Rejoso Watershed is a vital source of livelihoods for communities in Pasuruan, where the farming of annual and perennial crops and activities such as agroforestry, timber plantations, and livestock cultivation are the dominant sources of income. Over the past decade, stone mining has become an increasingly important source of alternative income for communities in the midstream area of the Rejoso Watershed. In the upper stream of Rejoso Watershed, adjacent to Mount Bromo, tourism is a significant alternative source of local revenue.

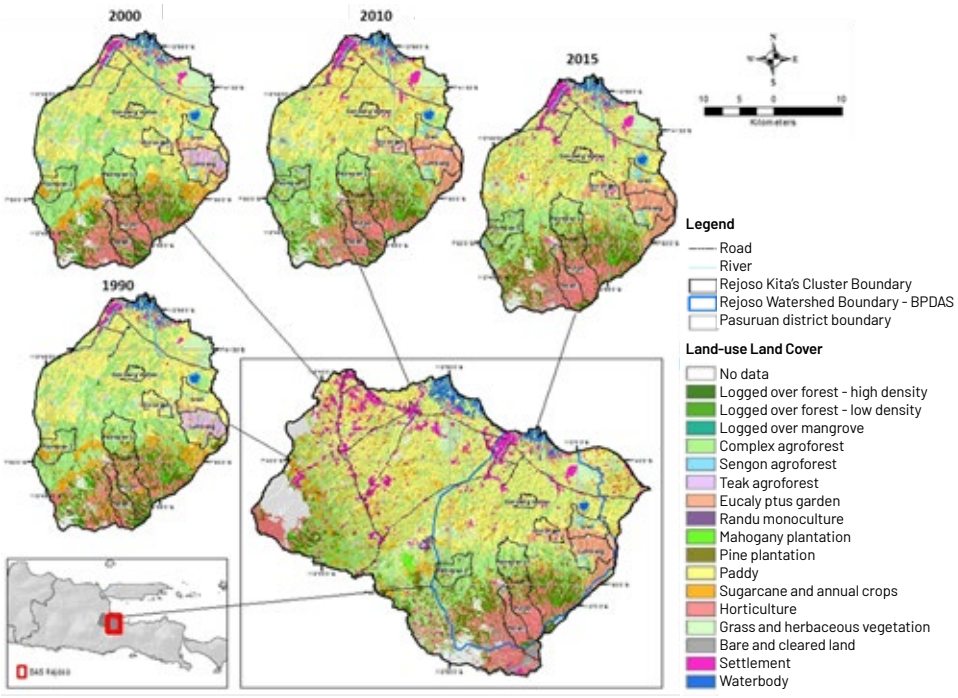


Figure 9. Land cover map of Rejoso Watershed

Population growth and economic pressures are causing dramatic changes to the Rejoso Watershed. Anthropocentric development activities are increasingly having an effect on environmental quality, most particularly on the watershed's function of ensuring supplies of water of good quality and in sufficient quantity. The most significant environmental issues related to water resources include floods, droughts, erosions, and landslides.

1.3 Rejoso Kita Phase 1 and 2 in summary

Through the implementation of Phase 1 of the Rejoso Kita project, a comprehensive, evidence-based road map and a business case for the management of the Rejoso Watershed and its water resources was developed, as follows:

- A series of research activities was conducted to develop a system-level understanding of people's livelihoods, with these activities related to farming profitability, vulnerability, resilience, options for sustainable agriculture, and an assessment of ecosystem functions (watershed functions, biodiversity, and carbon stocks) across various land use/cover types.
- The piloting of payment for ecosystem services schemes that engage smallholders in the up- and midstream areas of the Rejoso Watershed was conducted, with these pilots nationally recognized as exemplars of how to conduct the comprehensive design, pilot, and monitoring of a PES scheme.

- The project facilitated the development of a multistakeholder partnership, which was equipped with a road map and portfolio of business cases. The business case document was intended to increase awareness and to create a sense of urgency to protect the degraded watershed, to stimulate collective responsibility and actions, and to enable joint investment (financial and non-financial) among stakeholders involved in integrated watershed management and livelihood enhancement [6].

The roadmap and portfolio of business cases include recommendations for the next steps for conducting performance-based co-investment schemes in three different landscapes. The expected environmental impacts are reduced sedimentation and increased water infiltration in the upstream and midstream areas of the watershed, and increased efficiency in water consumption in the downstream area (see Figure 10). The schemes have been designed to be suitable to the context of the agricultural practices in the landscape. For example, for horticulture farmers in the upstream area, the activities included enrichment of cemara (Casuarina sp), a native tree species cultivated in horticulture land, while for farmers in the midstream area, measures to ensure the enrichment of trees cultivated on agroforestry land were implemented.

Rejoso Kita Phase 2 focused on increasing the efficiency of water use in the downstream areas of the watershed. To achieve this goal, Rejoso Kita piloted sustainable paddy cultivation technologies and methods and the construction of appropriately-designed artesian wells, with artesian wells being one of the main sources of water supply to irrigate paddy fields and to meet domestic needs [4].

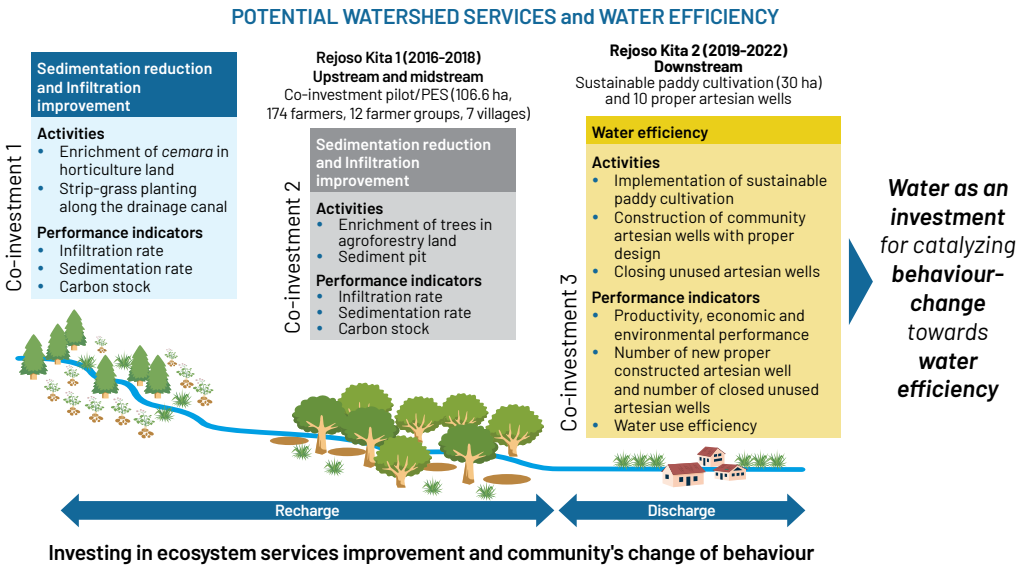


Figure 10. The co-investment schemes in the up-, mid- and downstream areas of the Rejoso Watershed

The Rejoso Kita project has also targeted a number of additional interventions to ensure the continuation and upscaling of the initiative. Phase 2 aims to achieve a number of objectives in the downstream areas of the watershed, as follows:

Economic Objective: The primary economic objective is to ensure the sustainability of water resources for various industries and businesses operating in the downstream areas of the Rejoso Watershed in Pasuruan.

- Social Objective: The primary social objective is to build awareness and to activate collective actions as a joint response to improving the efficiency of the use of groundwater. Institutionally, the Rejoso Kita project aims to revive water user institutions, to enable grass root institutions to better manage community wells, and to facilitate the newly enacted watershed forum (Forum Peduli DAS Rejoso; FPDR).
- Environmental Objective: The primary environmental objective is to increase water efficiency to 160 l/s by piloting water resource engineering management systems in the downstream areas of the Rejoso watershed, in anticipation of forecasted declines to the water level by around 10 percent each year.

To achieve those objectives, a number of activities have been implemented. Figure 11 presents outcomes and outputs of Phase 2 of the Rejoso Kita project intended to facilitate the achievement of the project's goals.

Reduced water balance gap inclusively in Rejoso ground water basin

- Robust information on socioecological characteristics of the downstream of Rejoso based on scientific and participatory approach
- Sustainable paddy cultivation demonstrated and monitored
- Voluntary community groups maintaining and monitoring efficient water use in Rejoso
- Water drillers with good technical skills and legality

Water as investment for catalysing behaviour-change towards water efficiency

- Environmentally aware agricultural, industrial and domestic water users
- Local business entities ready for managing and operationalizing water credits and water-supply business units
- HIPPA (local water user association) adopted good waste management and connected to municipality waste management facility (TPS3R)

Integrated water resources and watershed management governance implemented

- Inputs to national policy on integrated watershed and water resource management (Rejoso PES case at nat. level and gov. degree)
- Peduli Rejoso Watershed Forum with good governance for establishing and managing public-private partnership (PES intermediary).
- Participatory, interactive, online and integrated M&E tool for socio-ecological elements

Figure 11. Expected outcome and outputs of Rejoso Phase 2

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CHAPTER 2
LOCATION OF PILOT VILLAGES AND CHALLENGES RELATED TO WATER RESOURCES MANAGEMENT

Ni'matul Khasanah, Beria Leimona, Lisa Tanika, Aunul Fauzi

2.1 Eleven pilot villages

The focus area of the interventions was in eleven villages in two sub-districts (see Figure 12), Winongan (4,341 ha, 07°42'30 "–07°43'30" NL) and Gondang Wetan (2,692 ha, 112°54'30 "–112°57'0" LE), with paddy being the dominant form of land cover in both subdistricts. The two sub-districts were selected based on the following parameters: (i) the (high) number of artesian wells, used as a primary source to irrigate paddy fields; (ii) the (high) area of paddy fields; and (iii) (low) yields. Artesian wells, flowing twenty-four hours per day, are a specific characteristic of the volcanic study area, with the hydrology of the region characterised by a shallow artesian basin. In the two sub-districts, we worked in eleven villages selected based on the number of the artesian well (high), area of

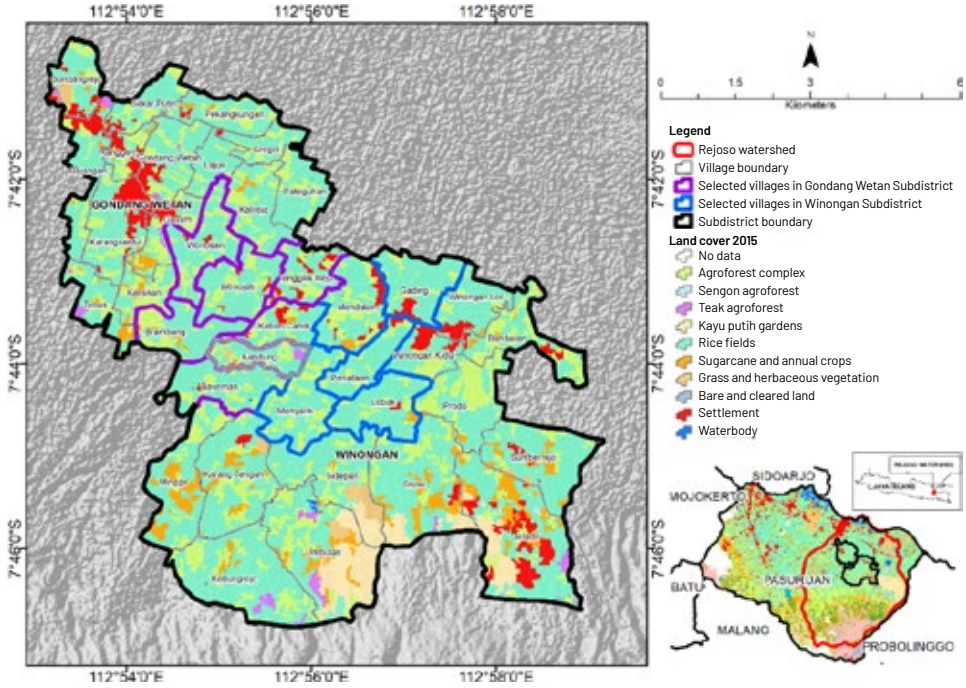

Figure 12. Boundary of the study area

paddy field (high), number of low-income families (high), and number of households with a member engaged in agriculture labour (high). The eleven selected villages were Wonosari, Wonojati, Tenggilis Rejo, Kebon Candi, Brambang and Bayeman (Gondang Wetan sub-district), and Gading, Mendalan, Penataan, Menyarik, and Lebak (Winongan sub-district).

2.2 Challenges related to watershed and water resource management in Pasuruan

To comprehensively resolve the environmental issues affecting Pasuruan District, it was essential first to identify the opportunities and challenges affecting the management of the watershed and water resources. To improve water resource management in the downstream areas of the Rejoso watershed, the following targets were set: (1) to demonstrate sustainable paddy cultivation as a means to achieve more efficient use of water and to reduce GHG by targeting irrigated-paddy smallholders; (2) to pilot good water management practices through the construction of properly-designed artesian community wells; (3) to strengthen the capacity and governance of the District Watershed Multistakeholder Forum to enable it to play an influential role in mainstreaming and scaling up the Rejoso Kita innovations. The following subsection describes the challenges related to water management in Pasuruan, as described by its local stakeholders.

2.2.1 Conventional paddy cultivation and individualistic farmers result in inefficient paddy production and water use

The average level of paddy productivity during the rainy season is deficient, increasing to moderate during the dry season. Therefore, selecting new and profitable paddy varieties and other inputs is needed. Farmers did not apply fertilizers of recommended types and in recommended dosages. Further, the excessive use of pesticides has resulted in the disappearance of predators and thus further increased the intensity of pest infestations and diseases.

A number of issues affecting the agricultural sector across Indonesia were also present in Pasuruan. In particular, young people in rural areas are generally not interested agricultural work, preferring employment in the industrial and services sectors. This may constrain the adoption of new technology that has the potential to improve productivity and result in labour shortages for agricultural production. In addition, farmers in Pasuruan tend to work individually, with farmer groups either not playing a decisive role or entirely absent. This creates issues related to water distribution for irrigation, as there is a lack of community or other mechanisms to coordinate this. Further, there is no organised communal system to clean debris from irrigation channels. All these issues resulted in paddy farmers receiving inadequate water

supplies, driving them to exploit artesian water by constructing inappropriately designed and constructed wells that were poorly managed.

Many farmers still consider that the volume of fertiliser used on the field is directly proportional to the level of productivity. Farmers are hesitant to use organic fertilizers because they believe that the organic matter may stimulate the growth of weeds. Thus, there is a need to facilitate behavioural change to increase the success of lowland rice farming. From the perspective of gender equity, the wages of male agricultural labourers are generally higher than for female labourers. Female labourers are generally involved in planting and mostly consist of older women.

A number of interventions have been proposed to improve paddy productivity in Pasuruan, including the following:

- Introduce an alternate "jajar legowo" planting pattern
- Use refugia crops to control pests and diseases biologically.
- Wider the area with crop rotation to reduce pest and disease intensity.
- Apply recommended dose and type of fertilizer.
- Encourage farmers to apply organic fertilizer as their assumption about it is invalid. It is necessary to demonstrate organic fertilizers and apply balanced fertilizers.
- Apply intermittent water management to irrigate paddy

2.2.2 A water-rich district with many hydrological problems

Pasuruan District benefits from abundant water resources, as its watershed contains an extensive water catchment area. Despite this, issues related to water still result in significant losses to farmers, with these issues relating to water shortages for agriculture and domestic use during the dry season and flooding during the rainy season. These water shortages occur because water discharge is decreasing. In short, the quality of watershed and water resource management is still inferior, resulting in persistent problems related to water quantity and quality within the watershed.

In addition, there are issues related to the governance of water use. *HIPPA* (farmers group) who use water (strategic) and *Ulu-ulu*/water regulatory officer (technical) should operate under the agency that manages water distribution, receiving payment from farmers who use their water management services. Unfortunately, the HIPPA was operational only for a short time and was no longer functional when the pilot commenced.

In water shortages, some farmers buy water and replace rice with sengon (*P. falcataria*), which may reduce their earning potential. Moreover, flooding frequently occurs due to infrastructure development (toll roads), private companies' usage, and carelessly disposed of waste materials that clog water drains. Industrial operators also face issues related to the supply of water for the operation of their businesses. This has been

exacerbated by the national Umbulan spring project to distribute water to other districts and cities outside Pasuran. Thus, there is intense competition for water resources, exacerbated by limited supply and inefficient use. In addition, there are issues related to water quality, with reported cases of industrial operations disposing of the waste directly into the district's rivers, with weak law enforcement in this regard. Community members contribute to this problem by using rivers for bathing and washing clothes without regard to the environmental impacts of their activities.


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2.2.3 The potential of a Multistakeholder Watershed Forum to transform water management

At least formally, watershed institutions already exist in East Java. However, these institutions need capacity building and other measures to enable them to play a more significant role. In particular, measures are needed to strengthen existing watershed forum functions, conduct more consolidated program planning, and analyse key actors to determine the opportunities and challenges related to the management of the Rejoso Watershed. The current watershed forum was implemented through a provincial gubernatorial decree, while Rejoso Kita's activities are mainly at the district level. The division of roles at each level must be more clearly defined and coordinated.


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CHAPTER 3
PROJECT WORKFLOW AND PROCESSES

Beria Leimona, Ni'matul Khasanah, Endro Prasetiyo, Yoga Lorensa Putra Yusa, Izhar Ashofie, Isnurdiansyah, Fitri Marulani, Adis Hendriatna, Lisa Tanika, Ali Pramono, Aunul Fauzi

There are many stages to the workflow of the Rejoso Kita project, with many associated processes. These include the formulation of evidence-based recommendations and decision-making processes, ensuring inclusivity in the engagement of local stakeholders, ensuring free prior informed consent in the implementation of innovations at the local levels, ongoing monitoring and evaluation, impact assessment, and the active communication of knowledge and lessons learned from the project. The main stages in these processes are as follows:

1. Initiating partnerships with a range of stakeholders at the village, sub-district and district levels;

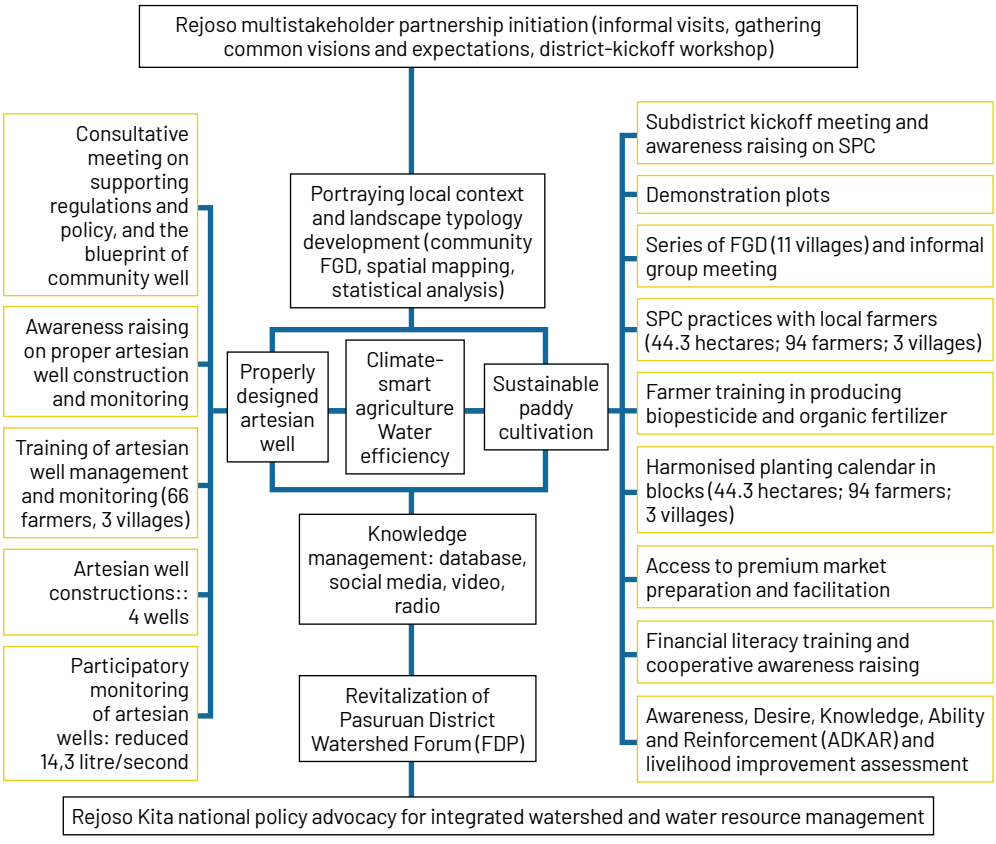

Figure 13. Action research workflow and processes of Rejoso Kita Phase 2

2. Determining socioeconomic, ecological and spatial conditions on the basis of landscape-approach research;
3. Facilitating research into sustainable paddy cultivation (SPC);
4. Supporting the community in the construction of artesian wells;
5. Communicating information related to the Rejoso Kita project using a range of different types of media;
6. Facilitating the revitalization of the Pasuruan District Watershed Forum;
7. Advocating for improved national policy related to integrated watershed and water resource management through public private people partnerships.

3.1 Kicking off the Rejoso Kita project

Project activities commenced with a number of visits to relevant Pasuruan district government offices to familiarize stakeholders with the project and to discuss planned activities and the related human resources required to implement them. The visits were also intended to establish a framework for coordination with key government agencies and to identify potential government support and available resources.

The Rejoso Kita project team met the Pasuruan Deputy District Head, Pasuruan District Secretary, and the Head of the District Planning Agency. Prior to these meetings, the team also visited officials from a number of agencies, including the Environmental Agency, Public Works – Water Resources Agency, Agriculture Agency, and Animal Husbandry and Food Security Agency. The project team introduced themselves to the subdistrict heads of Gondang Wetan and Winongan and to a number of village heads in the two sub-districts.

The Rejoso Kita team conducted the first district-level focus group discussions (FGD) on October 7, 2019 in Pasuruan to discuss the achievements of Phase 1 of the Rejoso Kita and to introduce activities that would be conducted in Phase 2 of the project. Amongst other matters, these discussions focused on lessons learnt in applying SPC in other districts. They involved 73 participants, of whom 32 percent were government officials,

Some documentation from visit to regional secretary office (kantor sekretaris daerah) and meet vice-district head, district secretary and head of planning agency.


Some documentation from the FGD.

5 percent representatives of NGOs, 12 percent from the private sector, 7 percent from academic institutions, 15 percent farmers, 12 percent representatives of the media, with the remaining 16 percent consisting of other stakeholders or interested observers. The FGD focused on opportunities and challenges in sustainable water management, SPC, and the revival of watershed forums and associated programs.

An informal meeting was also conducted with several members of Forum Peduli DAS Rejoso (FPDR) during the project kick-off seminar in October 2019, followed up by a visit to the chair of FPDR, who also served as the Head of the East Java Provincial Forestry Agency and is an official at the Public Works – Water Resources Agency.

3.2 The socioeconomic context and landscape typology

The focus area of Phase 2 of the Rejoso Kita project is the downstream area of Rejoso watershed (which covers ±2692 hectares Gondang Wetan subdistrict, and ±4341 hectares in Winongan subdistrict) with paddy forming the dominant form




Some documentation from the event

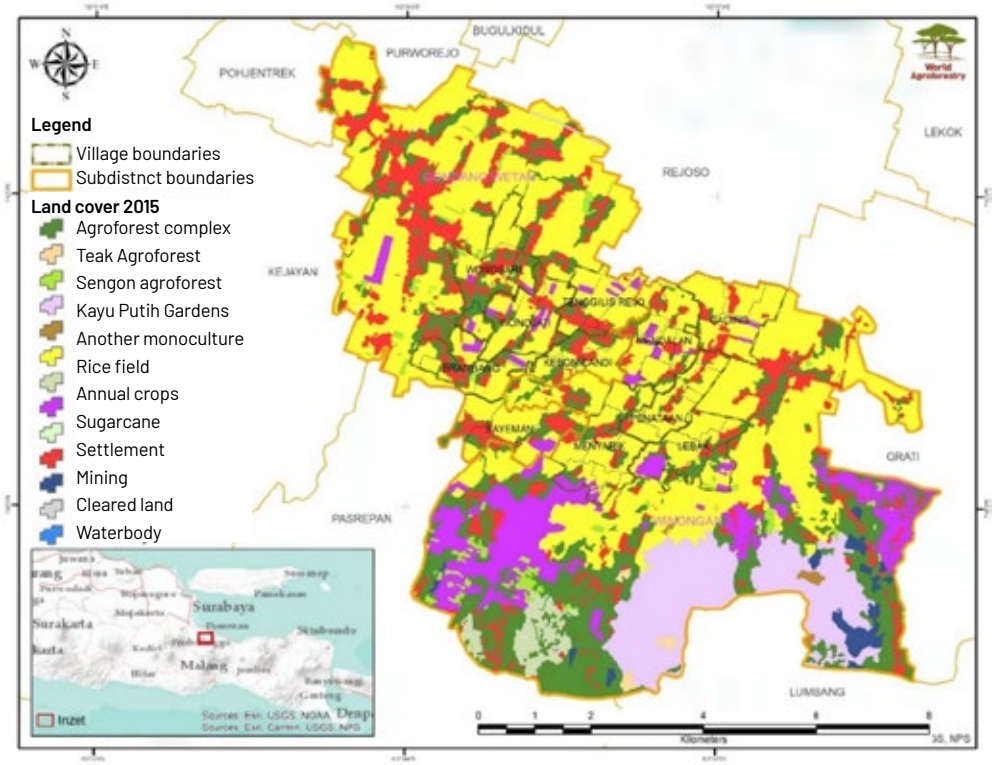

Figure 14. Land cover distribution in each sub district.

Source of Data: World Agroforestry (ICRAF)

of land cover. The two subdistricts were selected on the basis of the number of artesian wells (high), the area of paddy field (high), and the productivity of paddy (low). To gain a greater understanding regarding current local practices and issues related to paddy cultivation in the two subdistricts, the project conducted a series of FGD in October 2019. The FGD included a total of 251 farmers and 40 representatives of farmer groups from 11 villages.

The project also conducted participatory and spatial mapping exercises using drones to capture aerial photographs to gain a greater understanding of land cover composition and irrigation systems in the two subdistricts and thus to collect basic information related to the development of a paddy field typology for the selection of areas to be included in the pilot program. This process was intended to test and demonstrate SPC and improved artesian wells management techniques.

The development of the typology of paddy fields used parameters related to both types of paddy field management and paddy field area, percentage of area in which crop rotation was conducted, and flow density (*irrigation*). Each of the five clusters in the typology represents variations in farmers' practices in land management in the cultivation of paddy.

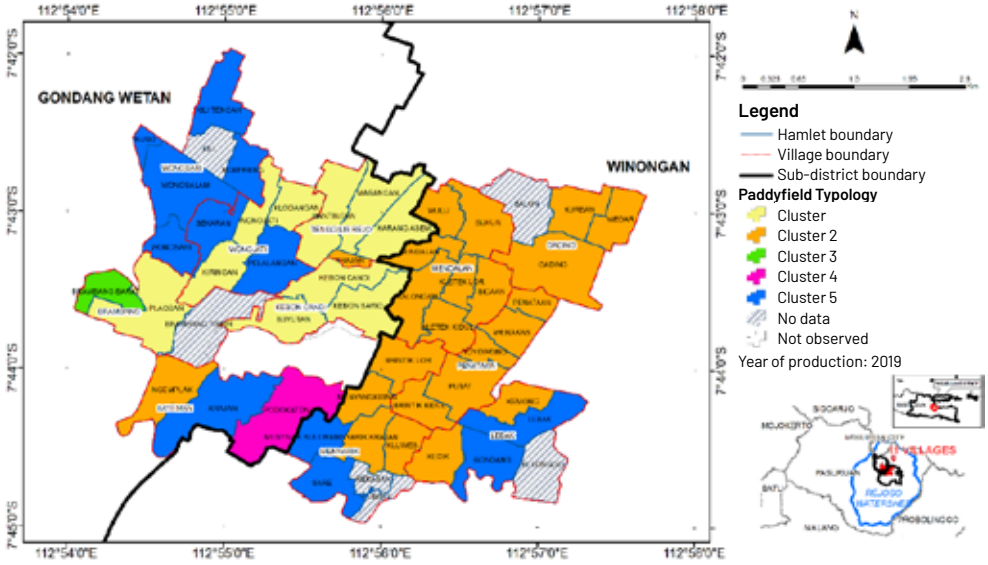

Figure 15. Map of typology of paddy field in eleven villages.

Source of data: World Agroforestry (ICRAF)

The development of the typology was intended to analyze and determine the risks related to the implementation of interventions and their upscaling in each paddy field cluster.

3.3 Sustainable paddy cultivation

3.3.1 Sustainable paddy cultivation demonstration plots

To raise awareness among the farmers and to encourage their participation in the SPC program, an FGD was conducted in collaboration with the Indonesian Agricultural Environment Research Institute (Balingtan) on October 8, 2019, at the Gondang Wetan subdistrict office.

Fifteen participants, including farmers/owners of plots and agricultural office representatives and extension officers, attended the FGD, which was opened by the subdistrict head of Gondang Wetan, Rachmat Syarifuddin, S.Sos.

The project developed demonstration plots to showcase the new SPC technologies and methods, which included improved water management, planting patterns, and fertilizer application. They were also intended to provide evidence of their ability to increase productivity in terms of both quality and quantity compared to conventional practices. Under the supervision of Balingtan, three farmers from two villages (Kebon Candi and Wonosari) in Gondang Wetan were involved in the establishment of these demonstration plots.

Some documentation from the event

The development of the demonstration plots involved a number of stages, including the selection of sites and farmers, the design of the plots, land and seed preparation (germination in nursery), planting, monitoring (water management, vegetative growth, GHG, pest and diseases intensity, productivity and profitability), and harvesting.

The results of the analysis of the demonstration plots and associated support packages were presented and disseminated through a series of FGD conducted between February and December 2020.

Land preparation for seedling

Seed float test to check the qualiy

Seedling

Land preparation before transplanting

Some documentation from the demonstration plot development

Transplanting

Some documentation from the demonstration plot development

3.3.2 Awareness raising to scale up Sustainable Paddy Cultivation

Following up on the success of the demonstration plots, the Rejoso Kita project conducted a series of semi-virtual FGDs to disseminate the findings and lessons learnt among farmers and to raise farmers' awareness and capacities to scale up the implementation of SPC.

The first FGD series was intended to: (1) share the results derived from the demonstration plot to raise farmers' awareness regarding SPC; and (2) discuss and identify constraints on its implementation and the support needed to adopt it on a wider scale. The first series of the FGD ran for 11 days (22 July – 12 August 2020) in 15 locations, with 397 participants from 92 hamlets from 11 villages.

The second FGD series was intended to: (1) share the results of the discussion of constraints and support needed during the first FGD series; (2) introduce a peer-to-peer lending platform that would serve as a Rejoso Kita partner to provide access to finance; and (3) to identify farmers willing to adopt SPC practices. The second series of the FGD ran for 10 days (17 September – 4 November 2020) in 15 locations, with 376 participants from 92 hamlets from 11 villages.

Limitations on the number of participants (maximum 30 participants) due to the Covid-19 pandemic restrictions presented a challenge to the implementation of the FGDs, which thus took longer than originally envisioned. These delays were exacerbated due to an increase in the number of confirmed Covid-19 cases in East Java and Pasuruan district during this time period.

Some documentation from the 1st series of FGD

3.3.3 Scaling up sustainable paddy cultivation

The process of scaling up SPC took place over two time periods. During the first period (the cropping season between January – April 2022), there were 22 participating farmers, covering an area of 8.7 ha of paddy fields and distributed across three villages (Kebon Candi, Wonosari and Gading).

During the second period, there were 94 participating farmers, covering an area of 44.3 ha. Support for the project was provided by both Danone Ecosystem Fund and the Rabo Foundation 44.3 hectares, with the former providing support for the project on 30 hectares and the latter providing support on 14.3 hectares. The area included in this period was distributed across seven villages, split into four cropping seasons.

3.3.4 Training to support farmers to benefit from the project: production of biopesticide and organic fertilizer

To support farmers in their implementation of SPC, the Rejoso Kita project organized a series of training activities related to the production of biopesticide and organic liquid fertilizers in 2021. Ninety-nine farmers from three villages (Gading, Lebak, and Penataan) participated in the trainings, which were facilitated by Mr. Bagus and Mr. Suprapto (agricultural extension officers from the District Agricultural Agency, experts on pest and disease control), and Ms. Kholifah (the recipient of Kalpataru, the highest environmental award in Indonesia, an expert on organic farming).

Documentation on a series of training on how to produce biopesticide during December 2021.

Table 4. A series of training on how to produce biopesticide

No.	Villages	Hamlets	Date of training	Number of participants
1	Gading	Gading	March 27, 2021	20 participating farmers from Gading village
2	Lebak	Lebak	August 19, 2021	32 participating farmers from Lebak and Menyarik villages
3	Penataan	Penataan	August 26, 2021	47 participating farmers from Gading and Penataan villages

3.3.5 Harmonized planting calendar

A significant benefit of SPC is that it can reduce the intensity of pest infestations and diseases and increase efficiency in harvesting and marketing a uniform quality of rice. However, these benefits are reduced if SPC techniques and methodologies are not applied uniformly across a contiguous area of significant size (*agglomeration*). To accelerate the adoption of SPC and to ensure that SPC is applied in an integrated block, rather than dispersed across noncontiguous areas, the project encouraged farmers to adopt '*tanam serentak*' practices across a contiguous block of land.

To target groups of farmers who had attained relatively high levels of proficiency in applying SPC, the project utilized the reverse auction approach. Land verification and performance-based agreements were developed before commencing the collective planting process.

3.3.6 Setting up in access premium market

The project facilitated farmers' access to markets and strived to ensure that they received better, more transparent prices for their produce. One means to achieve this was by facilitating farmers' participation with the Orisa rice brand. Orisa is a brand of healthy rice developed through a partnership between AQUA and HIPOCI and operated by Karya Masyarakat Mandiri (KMM). Marketed as a superior, more healthy product than regular rice, it also commands higher prices on retail markets. Following a series of meetings, agreement was reached regarding a market scheme, with KMM establishing a collaborative arrangements with farmers groups and a rice mill in Pasuruan.

3.3.7 Financial literacy training (micro finance)

In collaboration with the Rabo Foundation, the Rejoso Kita project facilitated farmers groups' participation in a microfinance cooperative to improve their access to loans and other financial products and thus to enhance their ability to implement SPC.

To prepare for this, the project facilitated a series of discussions to identify farmer group champions using the SWOT approach over the period from 11 October to 20 October, 2021, followed by a series of financial literacy training sessions over the period from 26 October to 27 October, 2021, and then by a series of awareness-raising activities related to the development of a cooperative, with these last activities facilitated by the District Cooperative Agency over the period from 25 October to 28 October, 2021.

These activities were conducted in collaboration with the Pasuruan District Cooperative Agency and KOSPIN Tekun of Boyolali (Central Java), with representatives of these agencies planning to establish a branch office in Pasuruan to support farmers in their implementation of SPC.

Each of these activities involved participants from six farmer groups, with the SWOT analysis involving 65 participants; the financial literacy training initiative involving 36 participants; and the awareness raising activities related to the development of a cooperative involving 66 participants.

Documentation from financial literacy training

A series of awareness-raising about the process of cooperative development

3.3.8 Awareness, Desire, Knowledge, Ability, Reinforce

To facilitate a shift in farmer behavior away from conventional farming practices and towards SPC, the project applied an *Awareness, Desire, Knowledge, Ability, Reinforce* (ADKAR) approach to interview 250 farmers, including both those who had and had not previously implemented SPC. These interviews were conducted in the period from October to December 2021 to collect information related to:

1. Levels of understanding of the purpose and importance of shifting from conventional practices to SPC, the degree of desire to make changes, the level of knowledge of ways to make changes, the current level of capabilities that would enable farmers to implement changes, and the support they would need to do this.
2. Existing constraints and efforts needed to support behavioral changes.

3.4 Sustainable Artesian Wells

3.4.1 Advocating regulations and policy to support effective watershed management

The Rejoso Kita conducted consultative meetings in the form of a hybrid webinar with relevant stakeholders at different levels to seek their inputs regarding plans to introduce appropriate construction techniques for safe, sustainable artesian wells and to discuss the cost profile amongst farmers in the downstream of Rejoso watershed. The webinar concluded that the proposed design of the artesian wells conforms to government guidelines regarding the extraction of groundwater.

The webinar was attended through zoom or YouTube by more than 500 participants. The webinar was moderated by Dr. Beria Leimona from the World Agroforestry (ICRAF), with presentations from Gajah Mada University (UGM), the Ministry of Energy and Mineral Resources, the provincial-level, water-related Public-

Figure 16. Webinar flyer

Works Service (PU SDA), the provincial-level Development Planning Agency, Water.org, Danone Aqua and ICRAF.

3.4.2 Raising awareness regarding appropriate artesian well construction and monitoring

The Rejoso Kita project conducted an online workshop to raise awareness regarding appropriate artesian well construction and monitoring techniques and methodologies on September 21, 2020. This workshop was attended by 67 participants from various backgrounds, including representatives of provincial, district, sub-district, and village government agencies, NGOs, and the private sector.

This workshop aimed to broaden participants' understanding of the urgent importance of sustainable groundwater resource management; to facilitate learning related to the Pasuruan District Government's irrigation management systems (Water-related public-works agency; PU SDA) to SPC (Agricultural Agency); to the Rejoso Kita project's strategy for groundwater resource management, and to introduce sustainable artesian well construction techniques and methodologies in the downstream areas of the Rejoso Watershed (ICRAF and Danone Aqua). This strategy was consistent with the provincial-level groundwater management policy (Provincial Energy and Mineral Resources Agency). The participants of the workshop were united by a common understanding that effective groundwater resource management should involve all relevant stakeholders, including those from the community, government, private and academic sectors.

An online workshop on groundwater resource management was organized on September 21, 2020

A series of FGDs was also conducted throughout villages in the area in which the project was conducted. The first series of these FGDs was intended to introduce the concepts and principles of sustainable groundwater management; to share proposed designs for artesian wells; and to discuss the various stages of well construction with the involvement of farmer/water user groups in well management and monitoring. The discussions were also intended to identify champions who would be capable of managing the new wells. The second series of activities was intended to share a draft of a collaboration contract with the identified champions, to be followed by a signing of the contracts and the commencement of well construction.

The first series of FGD introduce participants to the concepts of sustainable well management, covering issues such as water cycles, the differences between the proposed and current design of artesian wells, and the stages of well construction using the proposed design. It also covered issues related to the involvement of stakeholders and their respective roles, the verification of the location of new and old wells, well management and monitoring, including the opening and closing of valves, and cooperation contract points (well management and monitoring, benefits and consequences).

3.4.3 Well construction

The Rejoso Kita project successfully facilitated the construction of four pilot sustainable artesian wells in three villages, in Keboncandi (Gondang Wetan) and Penataan and Lebak (Winongan). The well in Keboncandi village was constructed over the period from November to December, 2020. The two wells in Lebak village were constructed over the period from June to August 2021. The well in Penataan village was constructed in August 2021.

3.4.4 Training of artesian well management and monitoring

A series of training activities related to the monitoring of newly constructed artesian wells was conducted for the members of farmers groups responsible for well

The series of 1st and 2nd FGDs on sustainable well construction and management

Training of participatory monitoring of discharge of the constructed wells and irrigation channel

management and maintenance. Sixty-eight members of four farmers group participated in the training sessions, which were conducted in three villages.

3.4.5 Monitoring process

The post-construction well monitoring process was conducted by farmer groups in the areas where the wells are located, following the project's provision of training related to monitoring procedures to the farmer groups. The monitoring process includes checking up on walls to ensure that all components are in place and work properly, calculating water discharge, measuring water flow, and monitoring irrigation channels to determine cleanliness, water levels, and water flow velocities. Monitoring is carried out once a week, with all data recorded on a monitoring record sheet, which is submitted to the project for evaluation.

3.5 Revitalization of Pasuruan District Watershed Forum (FDP)

A series of online and offline meetings with members of the FDP, environmental activists, academics, the media and representatives of local government local government and other public sector agencies during the second semester of 2021. A Technical Team was established to develop a road map for 2022–2027, including the strategic and operational plan for FDP. FDP successfully established a new organizational structure to ensure the representation of all relevant stakeholders in Pasuruan.

Series of meeting with FDP during the second semester of 2021

3.5.1 FDP field visit to Cidanau watershed

On August 24, 2022, a field visit was arranged for both members of FDP and representatives of district level government agencies, NGOs, the private sector, and farmers groups to Cidanau watershed to learn from the experiences of the Forum Komunikasi DAS Cidanau (FKDC) in the development and management of upstream and downstream linkages to establish a payment for ecosystem scheme to preserve Rawa Danau, an important water source for Cilegon Industrial Park and the Serang community.

Some pictures from the field visit on August 24, 2022

3.6 Rejoso Kita at the national level: policy advocacy for integrated watershed and water resource management

Two national-level workshops were conducted towards the end of August 2022 to disseminate information related to the Rejoso Kita project's activities and achievements to a range of stakeholders from national, provincial, and district level entities and agencies that play a role in ensuring the sustainability of the program.

The first workshop was held on August 23, 2022 at the Global Forest Hall of CIFOR-ICRAF Campus in Bogor. This workshop was attended by 65 participants including representatives of government agencies, NGOs, research organizations, and universities. The second workshop, held on August 25, 2022, was specifically intended to disseminate lessons learnt from the Rejoso Kita project in the area of integrated watershed management, with a particular focus on the implementation of payment for ecosystem services scheme in the Rejoso Watershed and the involvement of private sector entities from Pasuruan in initiatives related to watershed management and conservation. This workshop involved around 83 participants, including representatives of local and national government agencies, NGOs, private sector, research organizations and universities, and farmer groups.

Some pictures from the event

CHAPTER 4
DIAGNOSTIC OF THE PRODUCTION LANDSCAPE AND TYPOLOGY OF PADDY FIELDS

Ni'matul Khasanah, Lisa Tanika, Lalu Deden Yuda Pratama, Beria Leimona, Endro Prasetiyo, Fitri Marulani, Adis Hendriatna, Muhammad Thoha Zulkarnain

To identify prospective pilot locations in the Pasuruan downstream areas, we first sought to understand the socio-ecological characteristics of the production landscape and the risks involved in applying sustainable practices within it. In this chapter, we develop a typology of paddy fields based on a participatory approach and on a spatial data analysis that assessed the characteristics of different land cover types, farming systems that include irrigation systems, and the socioeconomic profiles of local communities. We then use this typology to assess a number of scenarios to support the piloting of sustainable paddy cultivation and upscaling and artesian well management. The participatory approach is intended to ensure that the piloting and scaling up of sustainable paddy cultivation and artesian well management will have high credibility amongst all community stakeholder groups at the village and district levels (Section 3.2).

4.1 Landscape scoping

4.1.1 Land cover and irrigation system mapping

To understand the current composition of land cover and the irrigation systems in the downstream area of the Rejoso Watershed, particularly in the Gondang Wetan and Winongan sub-districts, a detailed land cover map and an irrigation system have been developed for these two subdistricts to provide basic information for the development of a paddy field typology and for the selection of the areas for the piloting of sustainable paddy cultivation and artesian well management.

Land cover map of the two sub-districts

Table 5 and Figure 17 show the distribution of land-cover types in each of the two subdistricts. Paddy fields are the dominant land cover in both subdistricts, including areas that involve crop rotation (maize, long bean, cucumber and/or other annual crops) and those that do not. The land utilised for paddy fields covers a total area of 3197 ha, 36 percent (1558 hectares) of which is distributed in Winongan, with the remaining 61 percent (1641 hectares) distributed in Gondang Wetan. In Gondang Wetan, the next most prevalent form of land cover is for settlement, at 535 hectares (20 percent), followed by agroforest complex (396 hectares, 15 percent); and by sugarcane (60 hectares, 2 percent). In Winongan, following paddy fields, the next most dominant form of land cover is the agroforestry complex (982 hectares, 23 percent); kayu putih/ Melaleuca plantation (606 hectares, 14

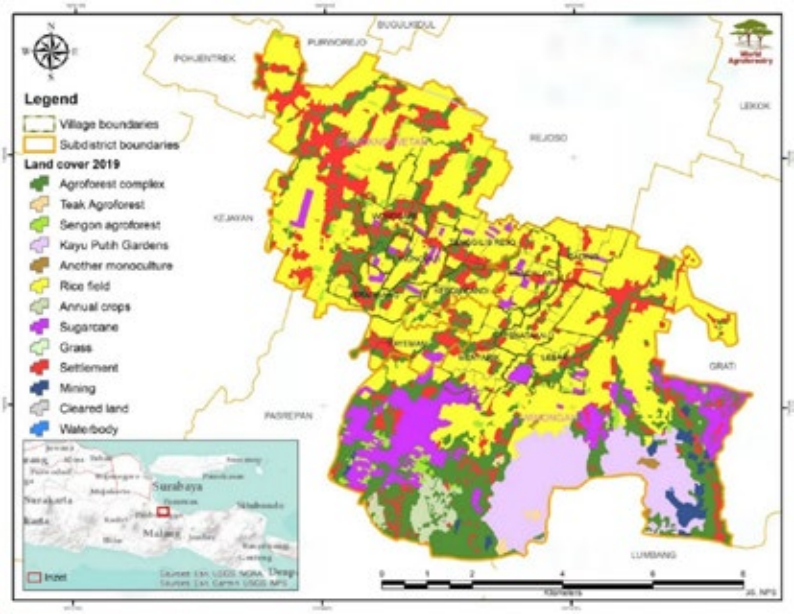

Figure 17. Land cover distribution in each sub-district.

Source of data: World Agroforestry (ICRAF)

Table 5. Land cover distribution in each sub-district

Land covers	Gondang Wetan		Winongan		Total	
	Hectares	%	Hectares	%	Hectares	%
Rice field	1641	61	1558	36	3199	45
Agroforest complex	396	15	982	23	1378	20
Settlement	535	20	375	9	910	13
Kayu putih (Melaleuca) gardens	0	0	606	14	606	9
Sugarcane	60	2	533	12	593	8
Sengon (Paraserianthes) agroforest	52	2	73	2	125	2
Annual crop	0	0	101	2	101	1
Mining	0	0	80	2	80	1
Teak agroforest	0	0	19	0	19	0
Other monocultures	0	0	13	0	13	0
Cleared land	7	0	0	0	7	0
Grass and herbaceous vegetation	2	0	1	0	3	0
Waterbody	0	0	1	0	1	0
Total	2692	100	4341	100	7033	100

percent); and sugarcane (533 hectares, 12 percent). Other forms of land cover include mining and teak agroforestry, with these found only in Winongan.

Land cover map of 11 villages

The most extensive area of paddy fields is found in the village of Gading in Winongan, which accounts for 81 percent of the total area (143 hectares). By contrast, the location with the smallest area of paddy fields is the village of Wonosari, in Gondang Wetan. The subsequent most prevalent forms of land cover in the 11 villages within the two subdistricts are agroforestry complex, sugarcane, and settlement (see Figure 18).

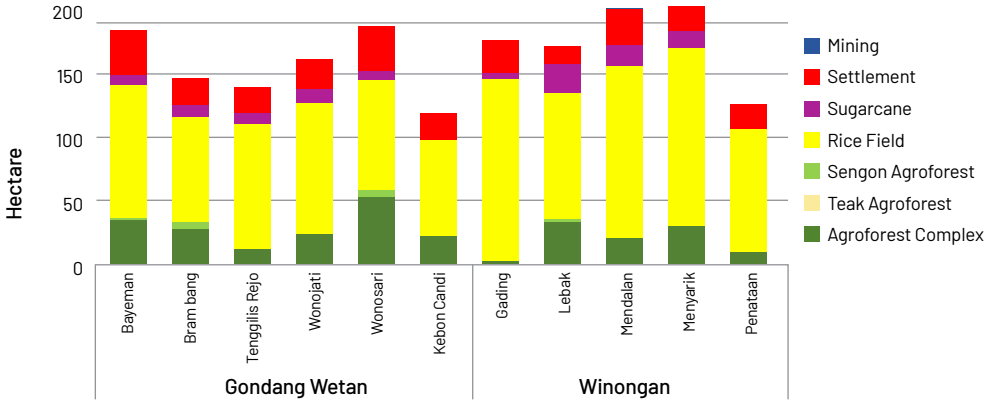

Figure 18. Land cover distribution in the eleven villages

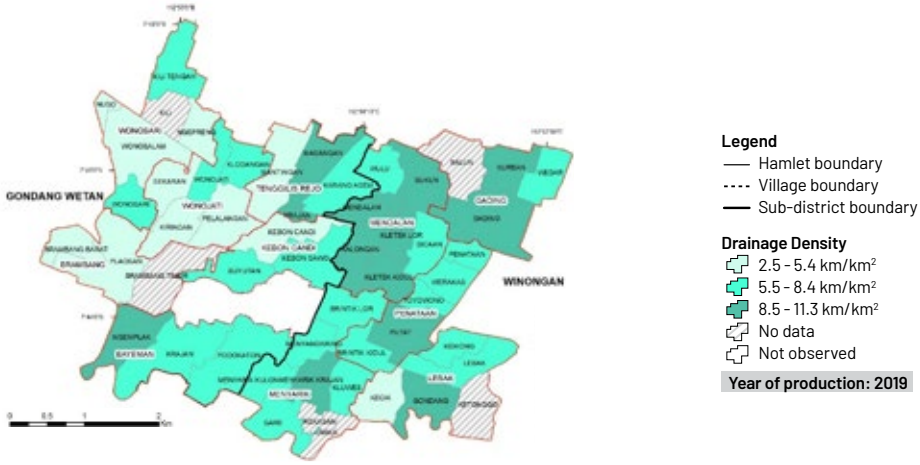

Figure 19. Spatial distribution of drainage density.

Source of Data: World Agroforestry (ICRAF) and Dinas Pekerjaan Umum – Sumber Daya Air (PUSDA)/Public Works – Water Resources Agency

Irrigation systems map of 11 villages

Figure 19 shows the drainage densities in each hamlet within the 11 villages. The value for these drainage densities is obtained by calculating the ratio of the total length of the irrigation system (km) and the hamlet area (km²). The irrigation systems include channels of different widths, with a distinction made between those less than 1 m and those greater than 1 m. In the case of channels with a width greater than 1 m, irrigation channels and natural rivers are differentiated. A number of hamlets in both subdistricts, including Sukun, Kurban, Gading, Kalongan, Kletek Lor, Kletek Kidul, Putat, Krajan, Gondang, and Mendalan in Winongan, and Karangasem and Ngemplak in Gondang Wetan, record high drainage density values, in the range of 8.5 -11.3 km/km². Figure 20 shows the distribution of the length of channels for each width class in each hamlet.

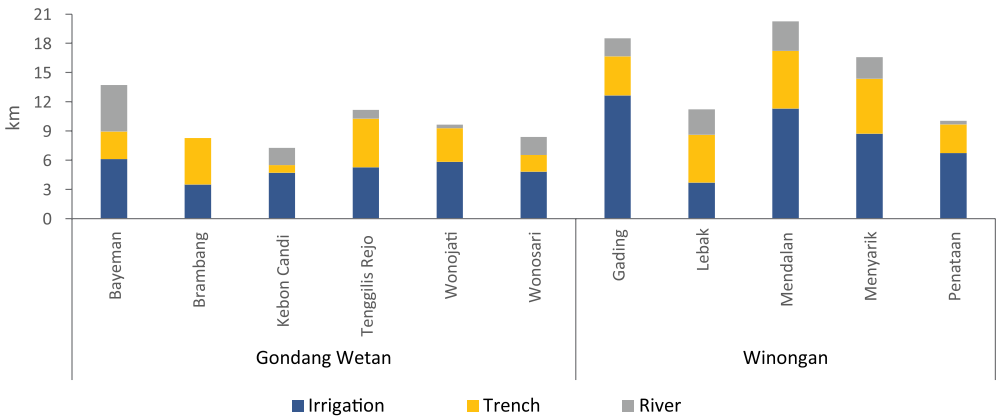

Figure 20. Distribution of length of irrigation channels for each width class in each hamlet

4.2 Typology of paddy fields

To understand the socio-ecological characteristics of the communities in the 11 villages in the downstream area, we have developed a typology of paddy fields for these eleven villages. In developing this typology, we have considered a number of parameters pertinent to paddy field management in addition to those described above (paddy field area, percentage of crop rotation area, and flow density). We surveyed the management of paddy fields to facilitate spatial data analysis of the land cover and irrigation systems data. Table 6 lists the parameters used to develop the typology. Figure 21 presents a map to describe the typology of the paddy fields in the eleven villages. Our analysis enabled us to identify five clusters of paddy fields in the eleven villages, with Table 7 and Table 8 describing the result of the cluster analysis and the characteristics of these clusters. The typology and the associated analysis provide a basis for selecting areas for piloting sustainable paddy cultivation and artesian wells management and for developing a number of scenarios to support the adoption and uptake of sustainable paddy cultivation.

A distinction between the five clusters is made based on variations in farmers' practices in managing the land and cultivating paddy. In the case of each cluster, unique information is provided to describe variations in the constituent parameters while still enabling an examination of the targeted landscape in its entirety. Intervention scenarios may include the provision of incentives for sustainable cultivation. These incentives may include providing insurance for stable agricultural inputs, microcredit facilities, and agricultural insurance, together with measures to improve market transparency and strengthen the capacities of farmer groups. Table 9 presents the results of our analysis, with a description of the risks related to intervention and upscaling in each paddy field cluster. When targeted for innovative interventions, clusters assessed to be at high risk will provide a gold standard for the success of these interventions, compared to those assessed to be at low risk.

Table 6. List parameters to develop paddy field typology and its methodology

No	Parameters	Unit	Method
1	Area of paddy field	%	Spatial data analysis
2	Flow density (irrigation, river and trench)	km/km^2	Spatial data analysis
3	Area with crop rotation	%	Spatial data analysis and FGD
4	Intensity of pest (rodents)	% of respondents	
5	Rice yield	Ton/ha	Survey
6	Dose of urea fertiliser (46% of N)	kg/ha	Survey
7	Dose of compound fertiliser (15% of N, 15% of P, and 15% of K)	kg/ha	Survey
8	Types of applied pesticide	Number	Survey
9	The presence of 'Ulu-ulu' as a water regulatory officer	Existing / not existing	Survey
10	Artesian wells	Number	Secondary data and FGD
11	River as the main water source	% of respondents	Survey
12	Types of water sources	Number	Survey

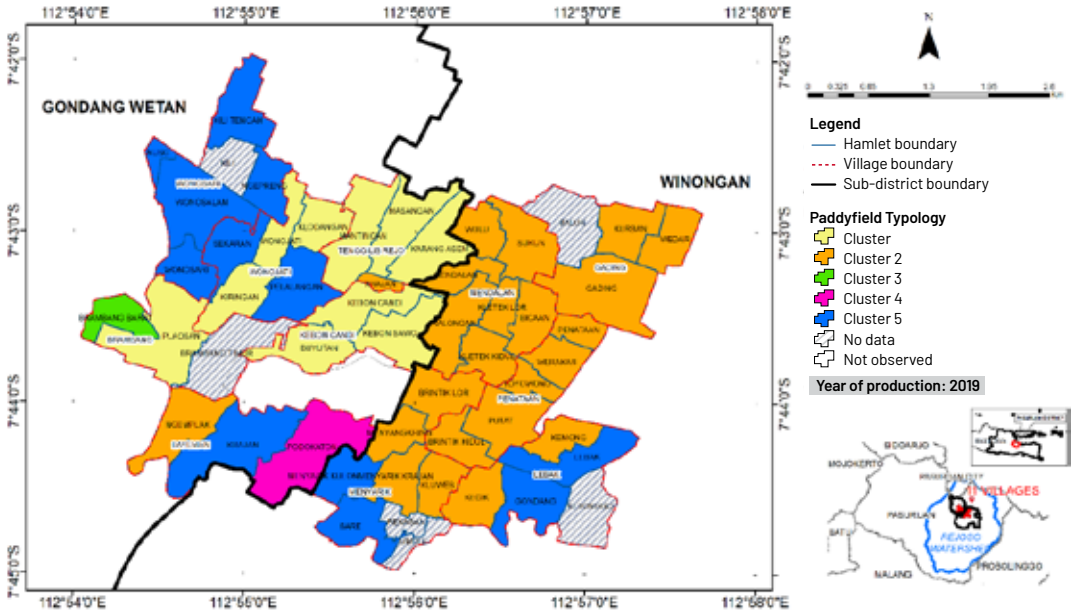

Figure 21. Figure 21. Map of typology of paddy field in eleven villages

Source of Data: World Agroforestry (ICRAF).

Table 7. The result of cluster analysis and characteristic results for the 12 parameters

No	Parameters	Unit	Clusters				
			1	2	3	4	5
1	Area of paddy field	%	High (218 ha)	High (407 ha)	Low (9 ha)	Low (29 ha)	Medium (230 ha)
2	Flow density (irrigation, river, and trench)	km/km²	Medium	High	Low	Medium	Low
3	Area with crop rotation	%	Medium	Low	High	High	Low
4	Intensity of pest (rodents)	% respondents	Medium	High	Low	High	Low
5	Rice yield	Ton/ha	Low	Low	Medium	High	Medium
6	Dosage of urea fertiliser (46% of N)	kg/ha	High	Low	Medium	High	Low
7	Dosage of compound fertiliser (15% of N, 15% of P, and 15% of K)	kg/ha	Medium	Low	High	High	Low
8	Types of applied pesticide	Number	Medium	Low	Medium	Medium	Medium
9	The presence of 'Ulu-ulu' as a water regulatory officer	Existing / not existing	Exist	Not exist	Exist	Not exist	Exist
10	Artesian wells	Number	High	Medium	Low	High	Medium
11	River as the main water source	% of respondents	Medium	High	Low	Low	High
12	Types of water sources	Number	High	Low	High	Medium	Low

Table 8. Description of each paddy field type

Clusters	Description
1	High paddy field fraction, medium drainage density, and a high number of artesian wells. While the usage of N fertiliser is high and that of compound fertiliser is medium, rice yields are low. The number of pesticide types utilised is medium. The area of paddy fields that use crop rotation is medium, as is the intensity of pests (rodents). The area of paddy fields that use rivers as the main source of water is medium, with a high number of other water resources. An 'Ulu-ulu' serves as the water regulatory officer.
2	High paddy field fraction and drainage density, with a medium number of artesian wells. The usage of both N and compound fertiliser is low, as are rice yields. The number of pesticide types utilised is low. The area of paddy fields that use crop rotation is low, hence the intensity of pests (rodents) is high. The rivers play a vital role, with these acting as the main water source, with a low number of other water sources. There is no 'Ulu-ulu' serving as a water regulatory officer.
3	Low paddy field fraction, low drainage density, and low number of artesian wells. The usage of N fertiliser is medium, while that of compound fertiliser is high. Rice yields are medium. The number of pesticide types utilised is medium. The area of paddy fields that use crop rotation area is high, and the intensity of pests (rodents) is low. The rivers play a limited role as a source of water, with a high number of other water sources is high. An 'Ulu-ulu' serves as the water regulatory officer.

Clusters	Description
4	Low paddy field fraction, medium drainage density, and a high number of artesian wells. The usage of N fertiliser is high, as are rice yields. The number of pesticide types utilised is medium. The area of paddy fields that use crop rotation is high, but the intensity of pests (rodents) is still high. Rivers play a limited role as a source of water, but the number of other water sources is medium. There is no 'Ulu-ulu' serving as a water regulatory officer.
5	Medium paddy field fraction, low drainage density, and a medium number of artesian wells. The usage of N and compound fertiliser is low, but rice yields are only medium. The number of pesticide types utilised is medium. The area of paddy fields that use crop rotation is low, hence the intensity of pests (rodents) is low. The rivers play a vital role as a source of water, with a low number of other water sources. An 'Ulu-ulu' serves as the water regulatory officer.

Table 9. Analysis and risk for intervention and upscaling of each paddy field cluster, based on feedback in local focus group discussions

Clusters	Analysis and risk
1	Cluster 1 has the potential for upscaling, with large areas of paddy fields and a high number of artesian wells. An interesting aspect of this cluster is that rice yields are low despite the high usage of fertilisers. The risk of technology failure due to pest infestations is medium, and there is a potential to expand crop rotation to increase soil fertility. Institutionally, there is a potential to improve water management by deploying an 'Ulu-ulu'. The risk for intervention and upscaling: Medium to low.
2	As with Cluster 1, Cluster 2 has good potential for upscaling. Unlike Cluster 1, Cluster 2 generally records low rice yields due to low agricultural inputs. Pest prevalence is high. There is no ulu-ulu (water custodian) in this area. The risk for interventions and upscaling: High. However, if the intervention is successful, it will provide a high standard and strong basis for upscaling in other areas with challenging conditions.
3	With a limited area of paddy fields, low drainage density, and a low number of artesian wells, Cluster 3 does not have excellent potential for intervention and upscaling. There are no obvious challenges regarding paddy cultivation. The risk for interventions and upscaling: Medium to low, but with a limited paddy field area, this area may be less suitable for interventions.
4	As in the case of Cluster 3, the limited area of paddy fields is a constraining factor for upscaling. However, it may be interesting to determine the factors that contribute to the relatively high rice yields and to see if these relate to patterns of usage of fertiliser or crop rotation. Thus, cluster 4 may function as a learning site, especially related to the application of crop rotation. The risk for interventions and upscaling: High to medium due to my pest intensity.
5	Analysis: Cluster 5 could have good potential for intervention and upscaling to test the application of the interventions were average, mild conditions prevail in terms of a number of aspects related to paddy cultivation. In particular, observing the role of 'Ulu-ulu' may provide interesting insights. The risk for interventions and upscaling: Low.

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CHAPTER 5
SUSTAINABLE PADDY CULTIVATION

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The downstream area of the Rejoso Watershed, which is located at an altitude of less than 100 m asl, is characterized by intensive smallholder irrigated paddy cultivation and sugarcane cultivation, with artesian wells used as the primary source of irrigation. The critical issues paddy farmers face in this downstream area include the declining fertility of farming land, a high intensity of pests and diseases, and low productivity levels due to unsustainable cultivation practices. In particular, the unsustainable cultivation practices are characterised by 1) an unharmonized planting calendar; 2) the excessive use of chemical pesticide; 3) the inefficient use of water resources; 4) the unbalanced application of fertilizer; and 5) the use of conventional planting patterns (see Section 5.1).

The average level of rice productivity in East Java stands at approximately 5.8 tons per hectare (BPS, 2020a), a figure slightly lower than that recorded in Bali, the province with the highest productivity, at an average of 6 tons per hectare. At the provincial level, East Java makes the second most significant contribution to national paddy production, at 19 percent of the total, with Pasuruan District contributing to about 3 percent of the national production (BPS, 2020b). Improvements to farming practices through the introduction of sustainable paddy cultivation technologies and their broad adoption throughout the area are crucial both to increasing productivity and maintaining ecosystem services.

The introduction of sustainable paddy cultivation technologies to achieve these aims is aligned with Indonesia's current policies and regulations (Section 5.2). To encourage the uptake and adoption of sustainable paddy cultivation practices and technologies, farmers have been exposed to these practices and technologies by establishing a demonstration plot in the downstream region of the Rejoso Watershed. The plot was intended not only to collect data and information related to various aspects of the technology and its application in this specific area but also to showcase evidence and to motivate farmers to adopt the practices by enabling them to compare the outcomes from conventional practices (i.e., conventional planting patterns, high chemical inputs, such as fertilizer and pesticide, and inefficient water use) with sustainable ones (i.e., optimal use of chemical inputs, improved planting patterns (*jajar legowo*) and water management regime regimes, and the use of biopesticide) (Section 5.3).

To develop and manage the demonstration plot, we collaborated with the Indonesian Agricultural Environment

Research Institute (*Balai Penelitian Lingkungan Pertanian*; Balingtan), a research institute under the Ministry of Agriculture of Indonesia.

5.1 Existing farming practices

To better understand current local practices and issues related to paddy cultivation in Pasuruan, particularly in the Gondang Wetan and Winongan sub-districts, we conducted a focus group discussion (FGD).

From this discussion process, it was found that the planting calendar revolves around three cropping seasons, as follows: Feb/March-May/June (cropping season 1); June/July – Sept/Oct (cropping season 2); and Oct/Nov - Jan/Feb (cropping season 3). However, it was also found that, on average, 55 percent of the village area's planting calendar is unharmonized, with not all farmers planting and cropping simultaneously. Some reasons for this inconsistency are as follows:

1. Impact of pests and diseases: In the past, pest infestations and diseases have led to crop failures. After such failures, farmers with greater access to business capital have been able to continue planting, while farmers with less access to capital tend to leave the land to lie fallow;
2. Lands owned/rented by farmers from other villages imply limited coordination between farmers operating the neighbourhood plots.
3. Inadequate labour for land preparation and planting: As a result, deviations of 15 – 20 days in planting dates can be expected.

FGD sessions to better understand current local practices and issues related to paddy cultivation.


Unharmonized planting calendar in the Pasuruan district, and not all farmers cultivate the lands simultaneously.

4. Inactive farmer groups.
5. Lack of active agricultural extension services.
6. Inadequate water supply (in certain hamlets only).
7. Limited availability of ploughs to prepare land: As a result of the lack of ploughs, deviations of 15 – 20 days in planting dates can be expected.

The lack of harmony in the farmers' planting calendar in a single block may increase the intensity of pest infestation and disease, leading to the greater application of pesticides. Thus, encouraging farmers to harmonise the planting calendar could reduce the intensity of pest infestation and disease, driving increased productivity. In areas with adequate water supply, these measures could also facilitate better water management practices, under the coordination of the local water regulatory officer (*ulu-ulu/antek*). A number of strategies to address the issues that result in the lack of harmony in the planting calendar could be considered, including the following:

1. The provision of financial support for farmers with limited access to business capital,
2. Increased mechanisation to address the lack of labour for planting and land preparation,
3. The increased uptake and use of biopesticide and refugia to control pests and diseases,
4. The revitalisation of farmers' groups,
5. The increased provision of extension services.

5.2 Policies and regulations relevant to sustainable paddy cultivation

Agriculture plays a vital role in Indonesia's food sector, accounting for 88.4 per cent of national food production (BPS, 2021). With Indonesia's current population of 273.5 million people (Worldmeter, 2022) expected to grow, the demand for food will also be expected to increase. In this context, paddy cultivation is vital, with more than 97 per cent of the country's population consuming rice (Total Diet

Study, 2014). In the global context, paddy cultivation is also highly significant, with rice consumed by more than 50 per cent of the world's population (Huang et al., 2015).

In 2021, Indonesia's total volume of rice production stood at 54.4 million tons of dried, milled grain (GKG), a decrease of 233.9 thousand tons (0,43 per cent) compared to the figure recorded in 2020 (54.7 million tons) (BPS, 2021).

One factor affecting rice productivity in Indonesia (and elsewhere) is the prevalence of the use of pesticides to combat pests and plant diseases and fertilizers to stimulate plant growth and development. Indonesia's paddy cultivation sector is characterised by the excessive use of synthetic pesticides and fertilizers, resulting in reduced soil organic matter content, decreased soil fertility, increased soil acidity, and environmental pollution (Ning et al., 2017). It has been shown that the excessive long-term use of synthetic pesticides can result in increases in residues in soil, plants, and water (Fenner et al., 2013). In addition, with continued use, pests and diseases can become resistant to the impact of these inputs, forcing farmers to increase doses, further exacerbating their use's undesirable impact.

Globally, rice cultivation is estimated to account for 1.5 per cent of total greenhouse gas (GHG) emissions, including CO_2, methane, and nitrous oxides, all of which have been demonstrated to increase the earth's surface temperature (global warming) through their greenhouse effects. The level of emissions produced and their management characteristics within the paddy sector are strongly influenced by cultivation practices, including irrigation, fertilization, and cropping patterns (Gaihre et al., 2015).

To increase Indonesia's rice productivity while simultaneously limiting its environmentally damaging aspects, it is necessary to introduce environmentally sustainable paddy cultivation technologies. In particular, a more environmentally friendly practice would involve four components: *jajar legowo* planting pattern; balanced use of fertilizers; pest and disease control that emphasises the use of biopesticides; and intermittent irrigation.

In recognition of the need to increase rice productivity and to control the adverse environmental aspects associated with its cultivation, the Indonesian government has enacted a number of regulations to promote sustainable paddy cultivation, including the Decree of the Directorate General of Food Crops of the Ministry of Agriculture No. 50/HK.310/C/2/2020, which contains guidelines for organic rice cultivation. Amongst other matters, this decree supports sustainable paddy cultivation by promoting organic fertilisers and biopesticides:

1. *Organic fertilizers:* Using organic fertilizers can reduce dependency on synthetic chemical fertilizers. The excessive use of synthetic chemical fertilizer for long periods can leave

residues on soil and damage the soil's physical, biological, and chemical properties.

2. *Biopesticide:* The use of biopesticide (an organic pesticide) can help control plant pest organisms (OPT). Biopesticide does not leave harmful residues in the soil and the environment. Biopesticide production is simple, using raw materials easily obtained from nearby agricultural activities, agroforestry fields, or home gardens.

In general, Indonesia's national agricultural development policies, as expressed in the RPJM 2020-2024 national five-year development plan, emphasise the following:

- Improved food quality, consumption, safety, fortification, and biofortification practices.
- The increased availability of sustainably-produced agricultural food products reduces price volatility and ensures the supply of staple foods and other necessities.
- Increasing the productivity of the agricultural sector, including through improvements to human resources, market certainty, and the welfare of farmers and other agricultural workers.
- Ensuring the sustainable utilisation of agricultural resources in the context of climate change, including through the increased adoption and usage of digital and the improved management of land and irrigation water resources.
- Improving the governance of Indonesia's national food system.

At the provincial level, East Java's provincial government has promulgated Gubernatorial Regulation No. 31/2020 on Farmer Corporation Based East Java Agricultural Area Masterplan for 2020-2024 to increase the productivity and quality of food crop production, with the masterplan containing the following components:

1. Promotion of the use of site-specific and season-specific seeds of high quality in each region and growing season.
2. Improvements to the cultivation system by increasing population per hectare, including by applying jajar legowo planting system.
3. Promotion of the balanced use of fertilizers, organic fertilizers, and plant/livestock waste.
4. The application of integrated preventive pest and disease control through the use of refugia, natural enemies, and biopesticide.

5.3 Demonstration plot to test and promote sustainable paddy cultivation

The first demonstration plot to promote and test sustainable paddy cultivation techniques and technologies was developed on an area of 0.46 ha and involved three farmers groups in two

villages, Wonosari and Kebon Candi, both in Gondang Wetan, in November 2019. With the complexity of conditions in the field, including the unharmonized planting calendar, the high intensity of rat infestations, and current management and monitoring (water and GHG), we were able to establish this plot of 0.46 ha, which was sufficient to meet the objectives of the pilot. The demonstration plot aims to provide evidence that sustainable paddy cultivation techniques and technologies could result in increased productivity and improvements in quality and quantity relative to conventional practices (see Sections 5.3.1 and 5.3.2).

In November 2020, we considered establishing a second demonstration plot with a slightly different design to the first, with the differences mainly relating to improvements in water management. Unfortunately, the second demonstration plot experienced crop failure due to the impact of La Nina-related phenomena (high intensity of rainfall and humidity), which led to an unusually high intensity of pests and diseases. Therefore, in August 2021, we decided to establish a third demonstration plot with a similar experimental design and monitoring process to the second demonstration plot (see Sections 5.3.3 and 5.3.4.). While the number of farmers involved was similar to that of the first demonstration plot, it covered a smaller area (0.21 ha), as the land used for the first demonstration plot in Kebon Candi was unavailable. Therefore, we shifted the plot to a neighbouring area with the same land ownership.

5.3.1 Design of the first demonstration plots

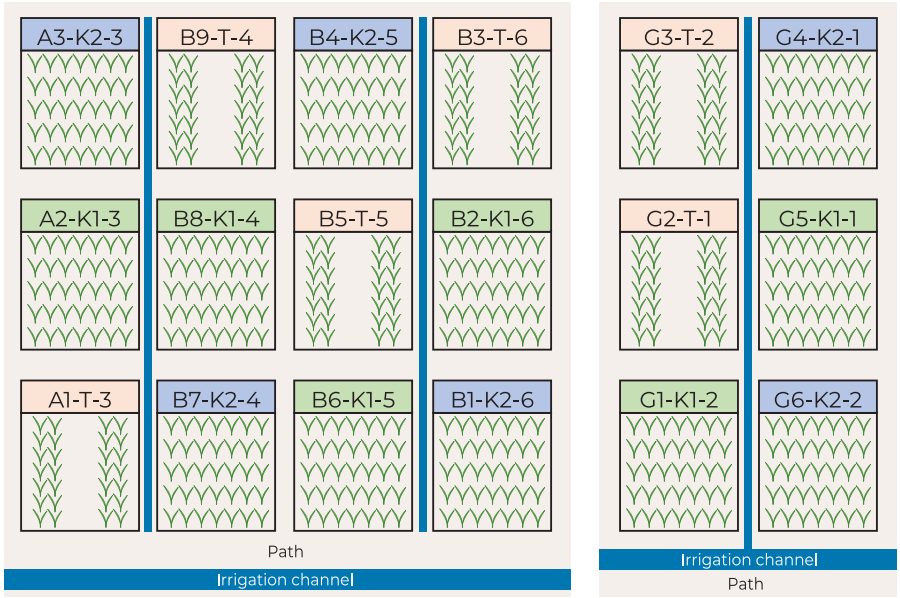
Table 10 presents the treatment packages we implemented to demonstrate sustainable paddy cultivation techniques and technologies. We also include current conventional practices as a baseline to enable comparisons. Each treatment package was replicated six times (on a total of 18 plots) and distributed on three farmers' land, with varying land sizes for each package treatment (see Figure 22).

Table 10. Treatment packages for introduced technology and current practices

No	Activities	Introduced technology (T)	Current practice 1 (K1)	Current practice 2 (K2)
1	Planting	Transplanted at 15 days old Alternate planting pattern 2:1: 20 x 10 x 40 cm	Transplanted at 15 days old Square planting pattern 20 x 20 cm	
2	Irrigation	Intermittent (5 cm above the surface soil)	Alternate wet and dry; tend to flood	

No	Activities	Introduced technology (T)	Current practice 1 (K1)	Current practice 2 (K2)
3	Fertilizer application	Organic fertilizer at 7 DBP (2 tons/ha) Dose of N, P and K based on soil test P is applied before planting 1st application I (1/3 N and ½ K) at 5 DAP, dose of N is based on leaf colour chart, dose of K is based on soil test 2nd application (1/3 N) at 20 DAP, dose N is based on leaf colour chart 3rd application (1/3 N and ½ K) at 35 DAP, dose of N is based on leaf colour chart, dose of K is based on soil test	Urea 175 kg/ha Phonska 200 kg/ha 1st application (130 kg urea/ha and 20 kg phonska/ha) at 9 DAP 2nd application (45 kg urea/ha and 180 kg phonska/ha) at 35 DAP	Urea 350 Phonska 300 kg/ha 1st application (260 kg urea/ha and 30 kg phonska/ha) at 9 DAP 2nd application (90 kg urea/ha and 270 kg phonska/ha) at 35 DAP
4	Pest and diseases control	Biopesticide and refugia	Pesticide	Pesticide

DAP: day after planting



Notes:
A – Owner of the land: Azizi B – Owner of the land: H. Bawon G – Owner of the land: Gufron
T – Introduced technology K – Current practices

Figure 22. Figure22. Lay out of the first demonstration plot

Land preparation for seedling

Seed float test to check the quality

Seedling

Land preparation before transplanting

Transplanting

First demonstration plot: from land preparation to transplanting.

Water management monitoring

GHG monitoring (sampling process)

Pest and diseases control (current practices)

Refugia to control pest and diseases

Demonstration plot performance to date (December 2019)

Monitoring the 1st demonstration plot

Ceremony of harvesting the 1st demonstration plot.

5.3.2 Results from the first demonstration plot

We successfully conducted the fir[st] demonstration plot on sustainable paddy cultivation with promising results in terms of productivity, profitability, and GHG emission. However, there is a need to conduct further measurements to determine the water-use debit between the conventional and SPC treatments. Further modifications to the water-use intervention were tested on the second and third demonstration plots.

Yield and profitability

Table 11 and Table 12 show the yields and profitability recorded from the demonstration plot. The introduced technology resulted in higher productivity, better benefit-cost ratio (BCR), and return-to-labour (RtL) compared to conventional practices.

Greenhouse gases emission

Table 13 shows levels of GHG emissions based on monitoring for a single cropping season. It was found that the introduced technology resulted in a lower level of emissions of greenhouse gas (GHG), including methane (CH_4) and nitrous oxide (N_2O), compared to conventional practices.

Water

Table 14 shows water level consumptions for the different treatments based on monitoring for a single cropping season.

Table 11. Yield from different treatments

Treatments	Harvest	Post-harvest	
	Grain (t/ha)	Rice (t/ha)	Water con. (%)
Introduced technology	9.0	4.93	15.0
Conventional 1	7.1	4.00	15.5
Conventional 2	6.8	3.88	15.7

Table 12. Profitability from different treatments

Treatments	RtL (IDR/Day)	Revenue (IDR/ha)	Benefit (IDR/ha)	BCR	RCR
Tech.	154,234	41,325,889	13,374,412	0.5	1.5
Con. 1	135,415	32,690,667	7,455,013	0.3	1.3
Con. 2	123,324	31,077,827	4,928,197	0.2	1.2

Table 13. GHG emissions with different treatments

Treatments	Emission (kg/ha/season)		Total emission	Emission intensity (ton CO_2eq/ton yield)
	CH_4	N_2O	Ton CO_2eq/ha/season	
Tech.	226	0.35	6.4	0.7
Con. 1	350	0.38	9.9	1.4
Con. 2	571	0.40	16.1	2.4

Table 14. Water consumption with different treatments

Treatments	Avg water demand (m^3/ha)		Productivity (ton/ha)	Water efficiency (L/kg grain)
	Kebon Candi	Wonosari		
Tech.	93,620	37,208	9.0	7549
Con. 1	89,343	35,875	7.1	7189
Con. 2	83,463	59,037	6.8	8783

The results showed that the introduced technology resulted in the increased consumption of water compared to the conventional use of conventional methods. Nevertheless, when the higher levels of productivity associated with the introduced technology are factored in, it can be seen that the introduced technology resulted in the consumption of 5 per cent less water per 1 kg grain than was the case with conventional technologies. We applied similar water management (intermittent) practices in the second demonstration plot but with a lower water level (0-2 cm).

5.3.3 Design of the third demonstration plot

Table 15 and Figure 23 describe in detail the treatment applied in the case of the third demonstration plot and its design. To establish a baseline, we also describe current practices (conventional techniques and technologies) in the same cropping season. Intermittent water management with a water level of 0-2 cm above the surface soil is compared with intermittent water management with a water level of 2-5 cm and conventional water management.

Table 15. Treatment packages for introduced technology and current practices

No	Activities	Introduced technology 1 (T1)	Introduced technology 2 (T2)	Current practice (K)
1	Planting	Transplanted at 15 days old Alternate planting pattern 2:1: 20 x 10 x 40 cm (jajar legowo)		Transplanted at 15 days old Square planting pattern 20 x 20 cm
2	Irrigation	Intermittent 2 – 5 cm	Intermittent 0 – 2 cm	Alternate wet and dry, tend to flood
3	Fertilizer application	Organic fertilizer at 7 DBP (2 ton/ha) Dose of N, P, and K based on soil test P is applied before planting 1st application I (1/3 N and ½ K) at 5 DAP, dose of N is based on leaf colour chart, dose of K is based on soil test 2nd application (1/3 N) at 20 DAP, dose N is based on leaf colour chart 3rd application (1/3 N and ½ K) at 35 DAP, dose of N is based on leaf colour chart, dose of K is based on soil test		Urea 175 kg/ha Phonska 200 kg/ha 1st application (130 kg urea/ha and 20 kg phonska/ha) at 9 DAP 2nd application (45 kg urea/ha and 180 kg phonska/ha) at 35 DAP
4	Pest control	Biopesticide and refugia		Pesticide and refugia

DAP: day after planting

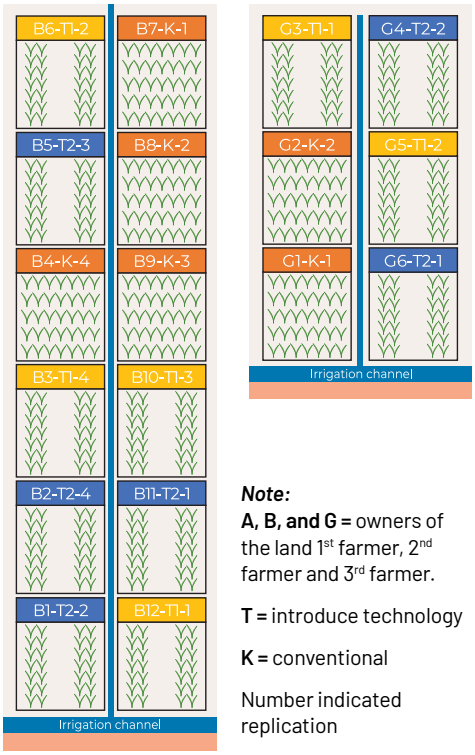


Figure 23. Lay out of demonstration plot

5.3.4 Results of the third demonstration plot

We successfully established the third demonstration plot to test and demonstrate sustainable paddy cultivation techniques and technologies. Promising results were recorded regarding productivity, profitability, GHG emissions, and water consumption.

Yield and profitability

Table 16 shows the grain productivity and profitability recorded for the third demonstration plot. The introduced technology resulted in increased productivity of 11 per cent – 13 per cent and a higher benefit-cost ratio (BCR) and return-to-labour (RtL) compared to conventional practices.

Greenhouse gases emission

Table 17 shows levels of GHG emissions based on monitoring for a single cropping season. It was found that the introduced technology resulted in a lower level of emissions of greenhouse gas (GHG), including methane (CH_4) and nitrous oxide (N_2O), compared to conventional practices.

Water

Table 18 shows water level consumptions for the different treatments based on monitoring for a single cropping season. The results showed that the introduced technology 1 resulted in increased water consumption compared to the conventional practice, while introduced technology 2 resulted in decreased

Table 16. Productivity and profitability from different treatments

Treatments	Productivity (t/ha)	RtL (IDR/Day)	Revenue (IDR million/ha)	Profit (IDR million/ha)	BCR
Conventional	9.4	128,867	42.5	12.3	0.41
Introduced technology 1	10.5	164,764	47.5	19.5	0.70
Introduced technology 2	10.8	168,819	48.6	20.6	0.74

Table 17. GHG emissions with different treatments

Treatments	Emission (kg/ha/season)		Total emission (ton CO_2eq/ha/season)	Emission intensity (ton CO_2eq/ton yield)
	CH_4	N_2O		
Conventional	68.8	0.5	2,054	0.22
Introduced technology 1	91.7	0.9	2,805	0.27
Introduced technology 2	40.8	0.5	1,287	0.12

Table 18. Water consumption with different treatments

Treatments	Avg water demand (m^3/ha)	Productivity (ton/ha)	Water efficiency (L/kg grain)
Conventional	75,543	9.4	8,075
Introduced technology 1	76,223	10.5	7,203
Introduced technology 2	66,191	10.8	6,220

consumption. The introduced technology 2 and 1 consumed less and more water compared to the conventional one, respectively. Nevertheless, when the higher levels of productivity associated with the introduced technology are factored in, it can be seen that both introduced technology 1 and 2 resulted in the consumption of 12 – 30 per cent less water per 1 kg of grain than was the case with conventional practice.

5.4 Constraints and support needed to scale up sustainable paddy cultivation

Figure 24 shows the results of the first FGD series, including the constraints identified through the process and the support of the participants felt that they needed to adopt sustainable paddy cultivation techniques and technologies. There was no significant difference in the type of support needed by the various clusters, with all clusters identifying facilitation to increase farmers' ability to adopt sustainable paddy cultivation as the most pressing need. This shows that there is still a significant need for extension services to support the cultivation of Indonesia's most critically important agricultural commodity. The need to strengthen farmer groups' capacities and facilitate access to agricultural machinery to eliminate labour limitations for land preparation, planting, and harvesting were also identified as significant needs, as was access to finance to meet costs associated with land preparation and the procurement of agricultural inputs. Farmers also stated that they would need other support forms to adopt the new practices, including insurance.

Table 19 shows the extent of farmers' willingness to adopt sustainable paddy cultivation techniques and technologies by submitting information related to their land, with 52 per cent (210 participants) stating that they would like to access a loan to adopt these technologies. With

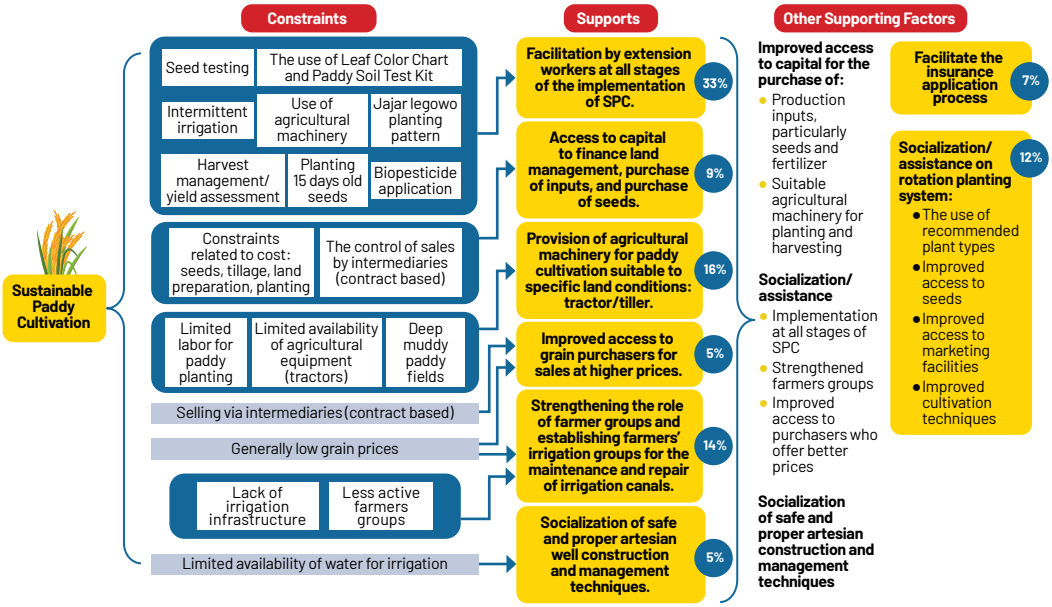


Figure 24. Identified constraints and supports needed to adopt sustainable paddy cultivation

Series of FGD to identify constraint and support needed to adopt sustainable paddy cultivation.

Table 19. Identified number of farmers who are willing to adopt sustainable paddy cultivation

Villages	Number of participants	Number of participants who are willing to adopt*)	Area (ha)**)	Would like to access loan
Bayeman	51	49	23.9	29
Brambang	26	26	12.0	12
Gading	59	59	32.3	25
Keboncandi	29	28	23.2	18
Lebak	35	32	20.1	17
Mendalan	42	42	31.4	22
Menyarik	55	54	25.7	38
Penataan	27	26	14.5	15
Tenggilisrejo	23	21	14.5	18
Wonojati	-	-	-	-
Wonosari	29	29	41.6	16
Total	376	366	239.2	210

**) indicated by submitting data, **) one farmer can submit more than one field and can be in a different block/landscape.*

this high level of interest in adopting sustainable paddy cultivation, as we mentioned above, follow-up discussions with smaller farmers group were also held between November to December 2020 to further propagate the information and identify additional farmers willing to adopt the new cultivation techniques.

5.5 Pilot, upscaling, and collective planting of sustainable paddy cultivation

The support and facilitation provided were intended to address a number of challenges and constraints faced by the farmers. A list of the types of support provided to individual farmers and farmer groups is listed in Table 20. Limited access to capital to implement the techniques was a significant constraint, mainly due to the proposed harmonisation of the planting calendar, with all farmers planting at the same time simultaneously on the same block. However, not all farmers would be able to access financial capital simultaneously. To address this, we collaborated with the Rabo Foundation (RF) and a fintech company to provide loans to targeted farmers through a peer-to-peer lending platform.

As a follow-up action, we facilitated measures to introduce a peer-to-peer lending platform and to simulate the farmers' budget, terms of payment, and interest rates when they participate in such schemes. The farmers generally expressed interest in participating in the loan scheme. Another series of discussions between ICRAF and a peer-to-peer lending platform and farmer champion was organized to reach an agreement regarding the financing scheme. In April 2021, several issues were discussed, including the provision by a peer-to-peer lending platform of dedicated staff to manage the loans and an agreement on different disbursement timing for various farmers.

However, in the end, it was not possible to implement the loan disbursements, with the peer-to-peer lending platform withdrawing from the partnership in May 2021. Reasons for the failure to manifest this project included the following:

Table 20. Support provided and commitment of farmers who adopt the sustainable paddy cultivation

Support		Commitment
Individual	• Leaf colour chart • 2L of biopesticide • Facilitation to access to finance	Implementing sustainable paddy cultivation: alternate planting pattern, intermittent irrigation, combined organic and inorganic fertilizer with dose follow leaf colour chart and soil test kit, biopesticide, crop rotation.
Group	• Soil test kit • A training to produce biopesticide • Facilitation in the implementation of sustainable paddy cultivation	Harmonized calendar of planting.

1. The peer-to-peer lending platform did not have sufficient experience to assess and deal with smallholders, with most of their current clients being primarily medium-size agribusiness. Thus, the peer-to-peer lending platform regarded the pilot with Pasuruan smallholders as high risk, potentially negatively impacting their loan portfolios, which are evaluated by the financing authorization body (OJK);
2. The peer-to-peer lending platform and the impact investor had difficulty agreeing on the timing of loan disbursements to align with periods when the targeted farmers would need these loans

Although the peer-to-peer lending platform decided to withdraw its support, the facilitation for the farmers has continued. To meet the costs associated with preparing land and procuring agricultural inputs, with support from Rabo Foundation and DEF, we have continued to provide grants to farmer groups, with the farmer using these grants to provide soft loans to their members, with an interest rate of 2.6 per cent per cropping season.

5.5.1 First stage: 8.7 ha sustainable paddy cultivation pilot

The above process facilitated the scaling up of various stages of the sustainable paddy cultivation project (see Table 21). In the first stages (January – April 2022 cropping season) (see Figure 25), the number of confirmed participating farmers was 22, covering 8.7 ha (from the target of 50 ha, 150 farmers), distributed in three villages (Kebon Candi, Wonosari and Gading). Table 21 shows the productivity of the 8.7 ha pilot compared to areas where conventional practices are implemented.

To support farmers who adopted sustainable paddy cultivation, we conducted training sessions related to the production of biopesticides.

Training on how to produce biopesticide

Transplanting from the first stage of scaling up of the sustainable paddy cultivation.

Figure 25. Map of the location of 8.7 ha area of sustainable paddy cultivation

Farmers nursing their paddy fields and a picture of paddy pests (right below)

Farmers harvesting their paddy

5.5.2 Scaling up of sustainable paddy cultivation

With an initial target of 40 ha (adjusted from an earlier target of 50 ha), the project facilitated sustainable paddy cultivation on 44.3 ha (94 farmers) through four stages of planting and harvesting, as described in Table 21 and Figure 26. The 44.3 ha (DEF 30 ha and co-funded RF 14.3 ha) were distributed across seven villages and split into four cropping seasons. Table 21 describes the productivity achieved due to the scaling-up process relative to productivity achieved with conventional practices.

Table 21. Progress of planting and harvesting of farmers who adopted sustainable paddy cultivation

	Stage 1	Stage 2	Stage 3	Stage 4	Total
Area (ha)	8.7	13.8	20.4	1.5	44.3
Number of farmers	22	28	40	4	94
Months of planting	Jan–Feb 2021	May–Jun 2021	Jun–Aug 2021	Aug 2021	
Progress on planting area (ha)	8.7	13.8	20.4	1.5	44.3
Number of farmers who have planted	22	28	40	4	94
Months of harvesting	Apr–May 2021	Aug–Sep 2021	Sep–Nov 2021	Dec 2021	
Progress on harvesting area (ha)	8.7	13.8	20.4	1.5	44.3
Number of farmers who have harvested	22	28	40	4	94
Total grant (IDR)	51.050.400	62.100.000	96.702.000		209.852.400
Average yield ± SD (SPC), ton/ha	2.2 ± 1.6	6.3 ± 2.4	6.3 ± 1.5	6.6 ± 0.6	
Average yield ± SD (non SPC), ton/ha	0.8 ± 0.3	4.3 ± 0.6	5.3 ± 1.6		
Continue practicing SPC	64%	100%	100%		

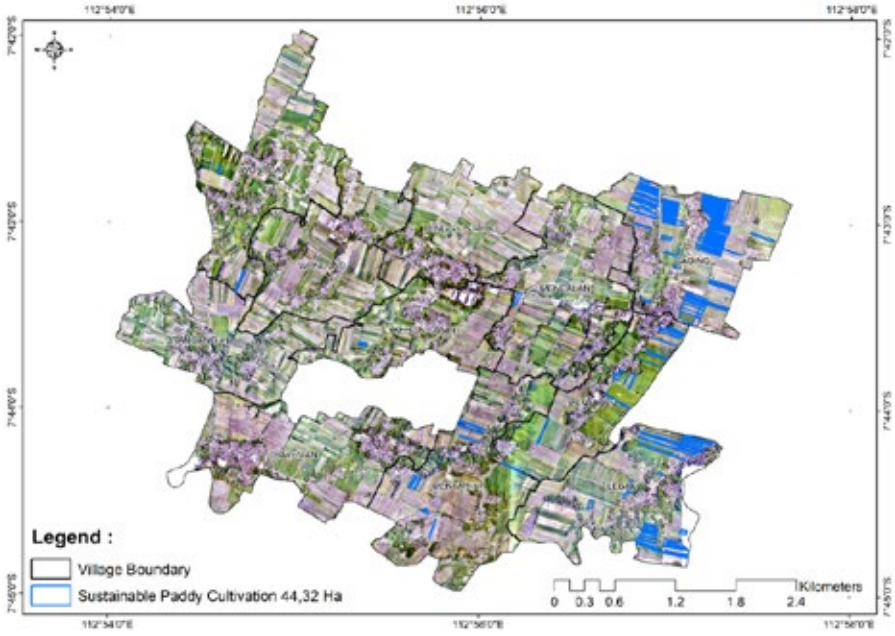


Figure 26. Map of the location of 44.3. ha area of sustainable paddy cultivation

5.5.3 Collective planting '*Tanam Serempak*' of sustainable paddy cultivation

To accelerate the adoption and uptake of SPC and to ensure that it was applied across an integrated block rather than dispersed across single plots, with support from RF, we engaged with farmers to facilitate their adoption of '*tanam serentak*' practices across the single integrated block. One of the advantages of harmonized SPC practices is that they reduce the intensity of pests and diseases and increase efficiency in harvesting and marketing a uniform quality of rice.

Awareness-raising sessions were organized to involve neighbourhood farmers whose land lay in the same block, targeting farmers who had not yet committed to adopting SPC. During the sessions, we gauged the willingness of farmer groups to implement the practices in a single integrated block according to the harmonized planting calendar and using a SWOT (Strengths, Weaknesses, Opportunities, and Threats) approach. The process involved negotiations regarding the activities and the support needed to enable them. Based on the results of the SWOT analysis (see Table 22), we formulated strategies to address a number of identified issues that needed to be resolved to implement the practices on a single block according to the harmonized planting calendar. After identifying their strategies, the planned activities and the support provided for the project implementation were revised.

Table 22. Strengths, Weaknesses, Opportunities, and Threats to implement SPC in one block on the same planting

Strength	Weakness
• Strong mutual work collaboration • Cohesive farmer groups • Abundant water resources • Solid interest in practicing SPC collective planting • Excellent soil condition for rice growing • Knowing producing biopesticide • Willingness to practice crop rotation	• Young generation is uninterested in farming • Irrigation channels not well maintained • Variation of land or soil condition: some very muddy, some porous • Insufficient or unavailability of capital to implement collective planting • Limited knowledge and experience with SPC • Limited knowledge of benefits of and commodities for crop rotation • Limited knowledge about the benefits of straight and organic fertilizer • Less frequent farmer group meeting • Farming tools and machinery not available • Vehicles for transporting manure for organic fertilizer not available

Opportunity	Threat
• Support from village government for farming (i.e., village fund for the improvement of irrigation channels) • Demand for rice is still high • Unlimited availability of straight fertilizer • Technical support for SPC and financial support from ICRAF • Use of organic materials (chaff or livestock manure) • Availability of straw crunching machine • Distribution of free seed from the government • Collaboration potential with other parties (for selling harvest, pesticide factory or distributor, credit or financing, etc.) • Farmers are skillful in producing farming or planting tools	• Unstable price of harvest / less interesting for farmers • Limited availability of ploughing tools (farmer's waiting list) • Pricey organic fertilizers • Less active expansion staff • Less active or no water distribution controller (ulu-ulu) • Hard to communicate (and cooperate) with landowners living in different villages • Ageing or unavailable planting workforce, not familiar with JarWo planting pattern • Planting JarWo is expensive • Subsidized fertilizers become more limited • Livestock breeders from different areas come to collect fresh straw

Strategies to improve SPC and post-harvest management

- Improving farmers' capacity to implement SPC and acquiring knowledge regarding the benefits of collective SPC planting and rotation with non-rice crops throughout a season.
- Increasing the frequency of farmer group meetings to focus on developing mutual-work collaboration to maintain irrigation canals, control pests and diseases, and other activities.
- Enabling agricultural extension workers to play more active roles in supporting farmers engaged in practicing collecting SPC.

Strategy to improve marketing and value chain

- Supporting farmer groups to collaborate with external parties to enable them to sell rice and other produce at higher prices.

Strategies to improve the institutional capacities of farmer groups

- Supporting farmer groups to establish Farmer Group Cooperatives to rent, sell and distribute farming machinery and tools, subsidized fertilizers, straight fertilizers, organic fertilizers, etc.
- Encouraging the involvement of the young generation in the activities of the Farmer Group Cooperatives
- Supporting farmer groups to better coordinate with the village government to obtain the necessary

support to implement SPC collective planting, with the support including the allocation of village funds to maintain irrigation channels, to provide straw crunching machines, to develop village regulations related to collective planting, to encourage water distribution controllers to play a more active role, and so on.

- Supporting farmer groups to establish partnerships with external parties such as rice mill operators to enable the farmers to use milling waste to produce organic fertilizers, with private parties to enable them to better control plant pests and diseases, and with financial service providers to improve their access to capital to support simultaneous planting, etc.

We utilized a reverse auction approach to target groups of farmers who could use high-efficiency SPC. Land verification processes and performance-based agreements were developed before commencing the collective planting. Table 23 – Table 25 presents a list of activities, a description of the support provided to farmer groups, and the terms of support payments for farmer groups who committed to implementing SPC on a single integrated block with a harmonised planting calendar.

The reverse auction was conducted two weeks following the awareness-raising sessions and was attended by seven farmer groups (96 members). The auction resulted in five winning farmer groups, whose land taken together covered 35.9 ha (119 farmers) (see Table 26 and Figure 27). In total, 24 per cent (29 farmers) of the winners were familiar with SPC. Thus, the project reached 184 farmers (65.1 ha) (see Figure 28) who had already adopted SPC, thus exceeding the established target. The productivity levels of all stages are presented in Table 21 and Table 26.

To support farmers engaged in collective planting, particularly those new to the process, we conducted a series of training activities related to biopesticide production in December 2021 (5, 10, and 15 December). More than 40 participants from Gading and Lebak villages participated in this training series.

Awareness-raising session on SPC toward 'tanam serentak' in one block.

Reverse auction session to target farmer groups who efficiently apply the collective SPC.

Table 23. List of activities for implementing sustainable paddy cultivation in one block on the same planting calendar

No.	List of activities
1	Planting collectively in one block, with a harmonised planting calendar, and using the same variety
2	Within 2 years, at least, one rotation with non-paddy
3	Maintaining irrigation channels
4	Groups have regular meetings to discuss plant growth monitoring
5	Attending training organized by ICRAF with speakers from the Bogor office
6	Planting, transplanted at 15 – 20 days old

	• Applying organic fertilizer at 7 DBP (2 ton/ha)
	• Dose of N, P, and K based on soil test P is applied before planting
	  • 1st application I (1/3 N and ½ K) at 5 DAP, dose of N is based on leaf colour chart, the dose of K is based on soil test
	  • 2nd application (1/3 N) at 20 DAP, dose N is based on leaf colour chart
	  • 3rd application (1/3 N and ½ K) at 35 DAP, dose of N is based on leaf colour chart, the dose of K is based on soil test

7	Applying alternate planting pattern 2:1 (20 x 10 x 40 cm) or 4:1 (20 x 12.5 x 50)
8	Maintaining irrigation by applying the intermittent 2 cm, irrigation days at 0 – 15 days after planting (DAP), 20 – 30 DAP, and 35 – 75 DAP
9	Controlling pests and diseases, using biopesticide with interval 1 – 2 weeks unless the intensity of pest and disease exceeds the threshold, the pesticide will be applied

Table 24. Support for farmer groups who are willing to implement sustainable paddy cultivation in one block on the same planting calendar

Support for each farmer group	Support for the individual farmer
Soil test kit to determine the dose of fertilizer (P and K), for farmer groups who haven't received it yet	Leaf colour chart to determine the dose of fertilizer (N), for farmers who haven't received it yet
A training to produce biopesticide, particularly for farmers who haven't joined the training yet	Compensation for delayed planting
Facilitation in the implementation of sustainable Rice cultivation	
Additional funds for land preparation and planting	

Table 25. Term of support payment for farmer groups who are willing to implement sustainable paddy cultivation in on block on the same planting calendar

Term of payment	%	Responsibility
Term 1 (before planting/ collaboration contract signing)	60	• Signing the collaboration contract • Developing the planting and monitoring calendar for 1 cropping season • Controlling pests and diseases • Applying organic fertilizer with the right dose.
Term 2 (two weeks after planting)	25	• Completing the planting process. • Controlling pests and diseases • Applying fertilizer with the right dose • Managing irrigation as recommended
Term 3 (1 week before harvesting)	15	• Controlling pests and diseases • Applying fertilizer with the right dose • Managing irrigation as recommended

Table 26. Winning farmer groups and average of productivity (ton/ha)

Village/hamlet	Farmer groups	Existing farmers		New farmers		Total		Average of productivity (ton/ha)
		Area (ha)	# of farmers	Area (ha)	# of farmers	Area (ha)	# of farmers	
Gading/Gading	Karya Tani	5.3	7	-	-	5.3	7	5.7 ± 1.3
Gading/Kurban	Tani Makmur	3.83	10	8.75	41	12.58	51	4.8 ± 0.5 *)
Lebak/Lebak	Tani Jaya	2.81	2	1.19	3	4	5	6.4 ± 1.0
Lebak/ Ketonggo	Sumber makmur jaya	3.19	10	3.03	16	6.22	26	3.9 ± 1.2 **)
Gading/Balun	Tani Barokah	-	-	7.81	30	7.81	30	6.4 ± 0.9
Total		15.13	29	20.78	90	35.91	110	

*) intensity of pest (rat) is higher than in other blocks, **) higher intensity of rainfall, some plots experience flooding

Figure 27. Location of SPC implementation in one block "tanam serentak"

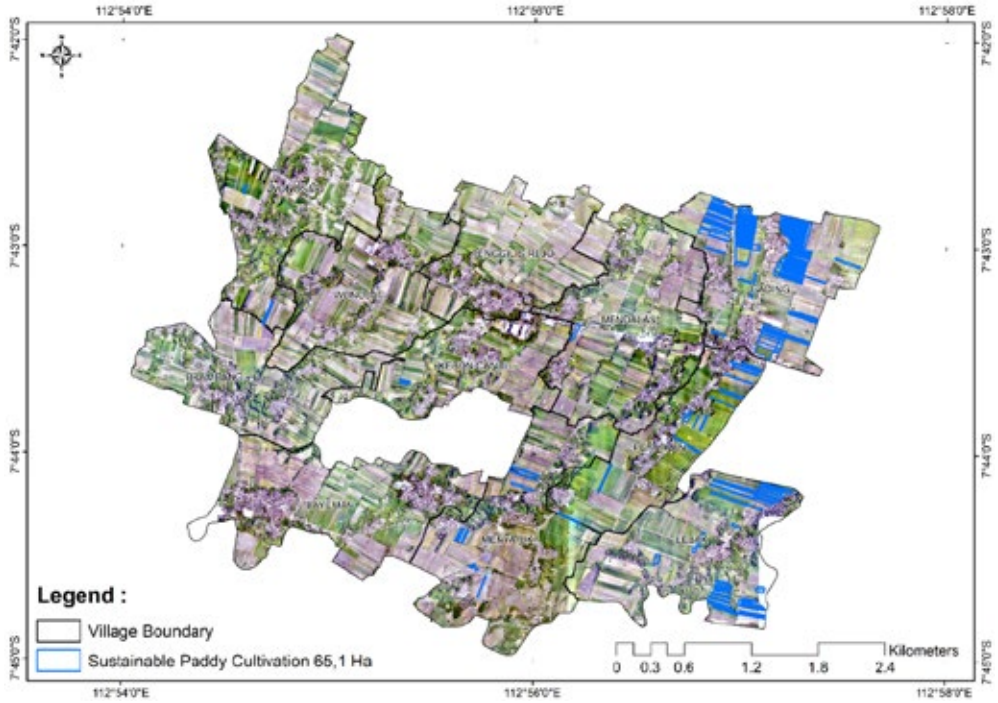


Figure 28. Map of the location of 65.1 ha area of sustainable rice cultivation

The process of planting of "tanam serentak" program.

The process of harvesting of "tanam serentak" program.

A series of training on how to produce biopesticide during 'tanam serentak" program.

5.6 Enhancing farmers' post-harvesting and entrepreneurship skills

The figures presented above illustrate the process of facilitating farmers to successfully adopt sustainable paddy cultivation and thereby improve their paddy productivity. The figures show that farmers who adopted sustainable rice cultivation recorded productivity levels 31-37 percent higher than those who utilised conventional practices (see Table 21). It should be noted that despite the recorded increases in productivity, participating farmers did not benefit from increased incomes, due to volatile and often lower-than-average market prices, with no price differentiation for healthy rice. For example, during the COVID-19 pandemic, local communities in Pasuruan received subsidised rice from the government, sourced from other regions. This resulted in reduced demand and a lower grain absorption rate by rice mills.

To address this issue, we conducted an initiative to enable the farmers to access premium markets (i.e. Orisa) to receive better prices for their produce. Orisa is a brand of "healthy rice," developed based on a partnership between AQUA and HIPOCI and operated by Karya Masyarakat Mandiri (KMM). The purpose of the collaboration with KKM was to explore the possibility of Orisa acting as the off-taker for the harvested paddy, at premium prices.

It was recognised that collaboration with Orisa could have a number of benefits, given that: (1) acceptance of the rice as suitable for sale under the Orisa brand indicates that it has met quality and food standards established by regulation of the Ministry of Agriculture; (2) The Orisa brand has not yet entered the Pasuruan market; (3) the process adopted in determining rice prices is transparent. Moreover, the farmers had demonstrated their commitment to producing healthy rice that met these standards and were willing to improve their capacities to enable their participation in this type of product.

As the next step, KMM established a collaboration with a champion representing the farmer groups and one of the rice mills in Pasuruan to develop a joint market scheme (Figure 29). As part of this process, KKM provided initial capital and packaging tools to the farmers. A pilot to test this process involves producing 800 kg of rice from a harvested area of about 0.32 ha.

However, in this endeavour, a number of challenges were identified, as follows: (1) the existing healthy rice supply chain resulted in the addition of a more significant number of actors, leading to a higher rice price that exceeded the top ceiling prices in the local market; (2) the number of medium-capacity rice mills that meet the Orisa brand's quality standards was limited; (3) the potential number of consumers of premium quality of rice in Pasuruan was limited, as the market for the healthy rice marketed under the Orisa brand is segmented. Further exploration of markets for healthy/organic rice outside Pasuruan is therefore required as measures to simplify the supply chain.

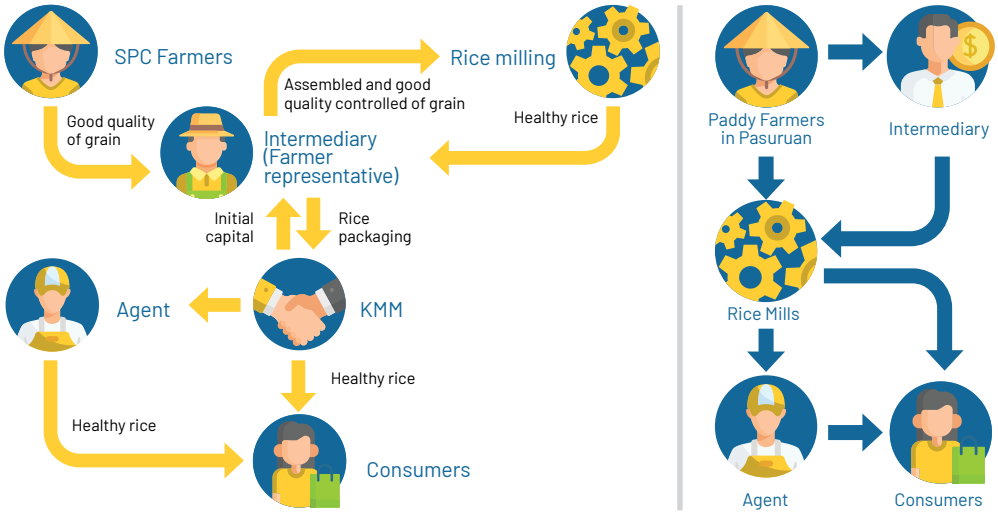


Figure 29. The market scheme implemented by KMM as the off-taker from the farmers implementing sustainable rice cultivation (left) compared to the existing market chain (right)

Harvesting and post-harvesting process of Pasuruan's healthy rice under the Orisa brand.

5.7 Socio-economic baselines and impacts of sustainable paddy cultivation

We conducted a household survey to determine socio-economic baselines and to enable an analysis of the impact of farmers' implementing sustainable paddy cultivation. In total, 250 farmers participated in the survey, including adopters and non-adopters of sustainable paddy cultivation techniques. Table 27 and Figure 30 show the survey results from two different analysis scenarios. Scenario 1 only measured results achieved during a successful cropping season when the profitability is positive, thus eliminating cropping seasons when crop failures were experienced. Scenario 2 measured results for cropping seasons with at least 25 per

cent harvests above the group average. Under Scenario 1, it was found that 758 plots recorded increases in income of 12-31 per cent, while under Scenario 2, it was found that 882 plots recorded increases in income of 15-25 per cent.

Table 27. Results of economic baselines and impacts of sustainable rice cultivation

Parameters	Scenario 1			Scenario 2		
	Respondent type A (n=59)	Respondent type B (n=302)	Respondent type C (n=397)	Respondent type A (n=71)	Respondent type B (n=349)	Respondent type C (n=462)
Productivity (kg/ha)	4,949	5,225	4,989	4,949	4,800	4,718
Total revenue	19,307,538	19,137,284	18,622,912	19,291,184	17,584,837	17,065,403
Cost						
Labour	9,007,640	9,597,394	9,820,903	9,461,212	9,730,598	9,933,151
Non labour	3,453,616	3,683,602	3,581,377	3,685,689	3,800,820	3,614,362
Total cost	12,461,256	13,280,996	13,402,280	13,146,901	13,531,418	13,547,513
Total profit	6,846,282	5,856,288	5,220,632	6,144,283	4,053,419	3,517,890
Ration R/C	1.55	1.44	1.39	1.47	1.30	1.26
% Income increment	31.1	12.2	Baseline	74.7	15.2	Baseline

Note: Respondent type A: farmers who adopted full components of sustainable rice cultivation, type B: farmers who adopted components of sustainable rice cultivation partially, type C: non-adopter of sustainable rice cultivation. The type C respondent represents the baseline condition as a reference to estimate income increases. Components of sustainable paddy cultivation: plant using jarwo planting pattern, control pests and diseases with biopesticide, apply intermittent water regime and proper dose of organic and inorganic fertilizer.

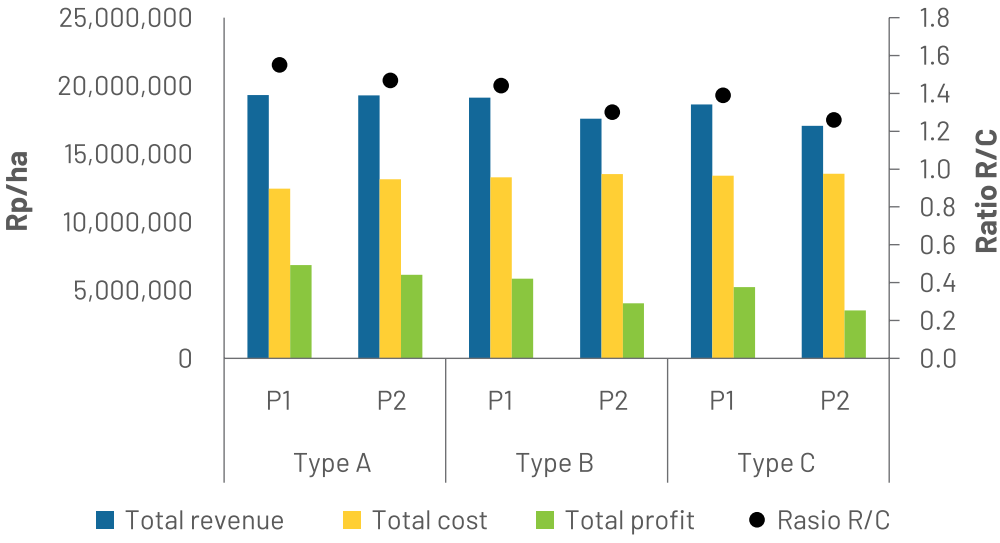
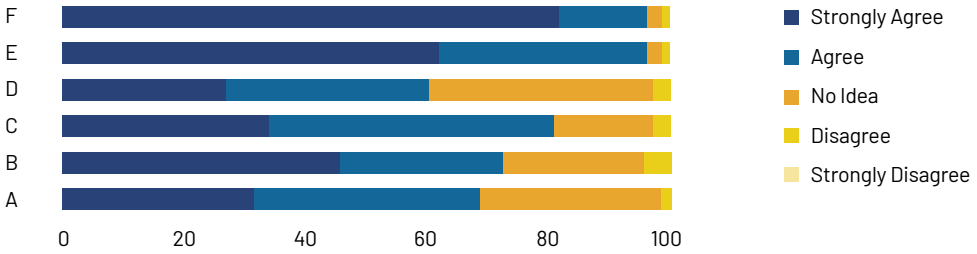


Figure 30. Results of economic baselines and impacts of sustainable paddy cultivation

5.8 Awareness, Desire, Knowledge, Ability and Reinforcement (ADKAR)

ADKAR framework was applied to assess farmers' perception of sustainable paddy cultivation and their behaviour toward adopting it. Figure 31 presents farmer perception of sustainable paddy cultivation. In all sustainable paddy cultivation components, more than 50% of respondents indicated strong positive responses.



Note: *A: SPC improves the quality and quantity of paddy grain and economic benefits (69% of respondents agree or strongly agree).*

B: The jajar legowo planting pattern improves the quality and quantity of paddy grain, pest control, and fertiliser application (73% of respondents agree or strongly agree).

C: Using balanced fertilizers can maintain grain production yields and soil fertility and reduce environmental pollution (81% of respondents agree or strongly agree).

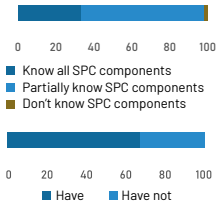
D: Using biopesticides can protect against natural enemies and reduce environmental pollution (60% of respondents agree or strongly agree).

E: Intermittent irrigation practices can reduce water use and increase production (97% of respondents agree or strongly agree). F: Collective planting can reduce the risk of crop failure (97% of respondents agree or strongly agree)

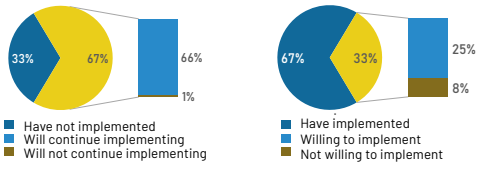
Figure 31. Farmer perceptions on SPC.

AWARENESS

- Of the 98% of respondents who were aware of all components of SPC (33%) or some components (55%), 67% have implemented SPC, either independently (32%) or through the facilitation provided by the Rejoso Kita program (35%)
- **The adoption rate stands at 61%**



DESIRE

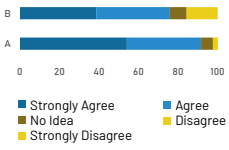


Of the **67%** of respondents who have implemented SPC, **66%** still intend to implement the practices, while of the **33%** of respondents who have not yet implemented SPC, **25%** want to do so.

REINFORCEMENT

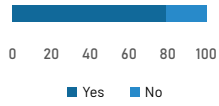
A: Knowledge on SPC needs to be disseminated and to become an integral component of government programs (92% of respondents agree or strongly agree)

B: Farmers can act as agents for the dissemination of SPC (76% of respondents agree or strongly agree).



KNOWLEDGE

79% of respondents think that **SPC has both advantages and disadvantages**



ABILITY

46% of respondents agree that **there exist significant obstacles in implementing SPC**

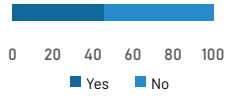


Figure 32. Potential adoption of SPC

Knowledge

To increase farmers' awareness regarding SPC, intensive, ongoing counselling is needed, together with the provision of training and mentoring of farmers and the establishment of demonstration plots on a broader scale to serve as a field school.

Ability

For farmers, the main obstacles in the implementation of SPC are (1) lack of knowledge regarding how to implement it and what the benefits are, (2) the high cost of implementing SPC for farmers, who often have limited access to capital, and (3) inadequate irrigation systems and governance. These obstacles could be overcome by providing counselling and assistance to support the continuous implementation of SPC, together with measures to facilitate access to capital and improve irrigation systems and governance.

Reinforcement

The government has adopted SPC as part of its agricultural programs, which are intended to improve the welfare of farmers. The government could also facilitate improved access to capital and production facilities so that SPC could be implemented on a broader scale by a more significant number of farmers.

5.9 Lessons in applying SPC in Pasuruan

5.9.1 Capacity building process

Sustainable paddy cultivation (SPC) is being introduced to respond to various problems experienced by rice farmers who use conventional techniques and technologies. Non-collective or non-simultaneous planting creates conditions that result in pest infestations and diseases, often driving farmers to use chemical pesticides in excessive doses, which can have toxic effects on plants and increases soil acidity. Excessive water use in volumes that often exceed the need for rice growth is also a significant issue, resulting in soil quality degradation.

The introduction and scaling-up of SPC in the downstream area of the Rejoso Watershed in Pasuruan, East Java, involved the following steps:

1. Establishing on-farm demonstration plots to showcase the performance of rice cultivation in terms of both the quantity and quality of harvests and volume of greenhouse gas emissions under various scenarios.
2. The scaling up of SPC in two sub-districts (Gondang Rejoso Kitatan and Winongan) through:
    a. Focus group discussion with members of farmer groups from eleven villages to disseminate information regarding SPC, assess farmers' interest in its

adoption, identify constraints, and determine the type of support needed for farmers to participate (e.g., financial support during planting).

b. First batch scaling up
c. Second batch scaling up
d. Exit strategy

The FGD and follow-up meetings revealed the following issues:

1. Issues Facing Farmers: Rice farmers in the downstream area of the Rejoso Watershed suffer persistent pest infestations, particularly involving rats and plant diseases. They are also impacted by the high and volatile prices of chemical pesticides; constraints on fertilizer access due to distribution and stocking issues; limited availability of labour; lack of capital for planting due to crop failures in the previous season; and a lack of government extension services.

2. Farmers Proposed Solutions: Farmers stated that they needed financial support in the form of soft loans, particularly in cases following crop failures in the previous planting season. Access to capital could be managed by farmer groups and repaid following the harvest.

3. Jajar Legowo 2:1 and 4:1 Planting Patterns: Farmers generally welcomed the use of these planting patterns, as it did their work during weeding, fertilizing, and spraying biopesticides easier and more efficiently. However, not all farmers were familiar with the techniques involved. They were also concerned that planting using jajar legowo patterns is more expensive than planting using conventional tile patterns.

4. Biopesticide, Local Microorganism, and Liquid Organic Fertiliser: To promote the use of these environmentally-friendly agricultural inputs, experienced facilitators are crucial to ensure optimum training results. Farmers welcomed the idea of producing organic biopesticide and fertilizers, given that the ingredients can be obtained from their surrounding environment. They also recognised that organic pesticides and fertilizers are cheaper than their chemical equivalents and less damaging to the environment. They were reassured that they would still be allowed to apply chemical fertilisers and pesticides for severe pests and diseases attacks. It was recognised that the shift from chemicals to organic materials requires a process, especially in dealing with weeds, which may result in high cost for farmers if the treatment is unsuccessful or takes too long.

5. Using PSTK and LCC to raise awareness of the benefits of SPC:

6. Paddy soil test kit (PSTK) and leaf colour charts (LCC) increase the benefits of SPC. Combined use of fertilizers would help to improve soil conditions in the long-term and

that the excessive use of chemical fertilisers would cause plant toxicity and increase soil acidity. While PSTK and LCC are simple and easy-to-use, it was recognised that elder farmers would need extra training and facilitation.

7. Intermittent irrigation: Intermittent irrigation has proven beneficial for the environment, significantly reducing greenhouse gas emissions. Rice is not an aquatic plant that requires continuous irrigation or watering. Introducing safe and proper well construction technologies by Rejoso Kita would enable farmers to control the volume and timing of irrigation water used to cultivate their rice crops, with SPC requiring ongoing monitoring of water levels. With farmers now more aware that excessive watering can increase soil acidity, they are willing to take steps to reduce their water consumption.
8. The role of government agricultural extension services and staff: Government agricultural extension staff need to establish better communication with farmers. More intensive facilitation by extension staff is required to ensure farmers apply all the components of SPC consistently.

5.9.2 Financing of SPC

With the peer-to-peer lending platform's withdrawal from their commitment to support smallholder farmers in the implementation of sustainable paddy cultivation and as part of formulating an effective project exit strategy, and with support from RF, we have explored alternative options to provide financing for smallholders. Two options that have been considered are as follows:

1. The establishment of a cooperative by the farmers' groups and their members.
2. Participation in an existing saving and loan cooperative.

The establishment of a cooperative by the farmers' groups and their members is consistent with President Joko Widodo's mandate for the development of farmer corporations. By organizing themselves in cooperatives, the farmer groups could develop a business model to support the implementation of SPC, enabling them to rent agricultural machinery, to cooperate with offtakers who provide better prices (i.e. through Orisa), and to enter into a partnership with an established savings and loans cooperative, amongst other benefits.

SWOT analysis for establishing cooperative in Pasuruan

The SWOT analysis showed that while farmers in the pilot areas had high levels of willingness and enthusiasm for SPC, they still had the insufficient capacity and capital to establish an independent cooperative, at least shortly (see Table 28). Thus, the groups decided to collaborate with an existing cooperative to enable increased access to agribusiness financing. In line with our facilitation of

Table 28. Summary of SWOT analysis of farmer groups in establishing farmer group cooperatives

Strengths	Weaknesses
• Most of the farmer group members have experience in implementing SPC • The farmer group members have high enthusiasm and willingness to move forward to establish a farmer group cooperative • The chairperson of the farmer group plays an active role in facilitating group activities • The grant provided by the Rejoso Kita project can become an initial capital for establishing a farmer group cooperative. • There are unutilized buildings in the villages that are the potential for locating a cooperative. However, the building must possess a public building permit to construct a cooperative office further.	• There is still a significant number of inactive group members. • The number of individuals who have capacities to manage the cooperative is limited. • Knowledge of cooperative is still lacking. • The risk of a non-performing loan is considered high.
Opportunities	**Threats**
• There is a potential collaboration with the agricultural inputs shops and the village business unite (BUMDesa) • The village youths are willing to participate in the cooperative committee. • Awareness raising and supports from cooperative agency exist. • The village head is willing to coordinate and support the cooperative.	• The cooperative may compete with the existing middleman to buy the rice harvest. • The young generation has low interest in agriculture. • There is still limited support from the government for innovations at the farmer levels.

farmer groups to develop a cooperative, we conducted a series of financial literacy training activities to develop the capacity of farmer groups to conduct bookkeeping.

Alternative solution for Farmers' Financing - Collaboration with Koperasi Simpan Pinjam (KosPin) Tekun

We endeavoured to facilitate the development of a partnership with a well-established saving and loans cooperative, namely KosPin Tekun, as an alternative provider of financial services for the farmers following the withdrawal of the peer-to-peer lending platform. The cooperative is headquartered in Boyolali, Central Java, and has acted as a partner of the Rabo Foundation since 2015. In 2022, after receiving financial support from the Rabo Foundation to expand its reach to underserved farmers in Pasuruan (including those in Rejoso), KosPin established a new branch office in close proximity to the project site. The expansion was consistent with KosPin's broader strategy of transforming itself from a regional cooperative to a national cooperative.

In addition to the support provided by the Rabo Foundation, we also explored the establishment of a cooperative alliance with PIP, a government-managed investment centre under the Ministry of Finance that channels ultra-micro financing (UMi) funds throughout East Java. A series of meetings was held to

Audience of KosPin Tekun with District Cooperative Agency

Discussion of KosPin Tekun with ICRAF team and farmer group representatives.

explore the possibility of UMi being used to support farmers who adopt SPC. During the meetings, it was determined that for PIP to provide support, one of the conditions was that SPC be conducted for more than one cropping season. Given this condition, it may be possible to leverage this opportunity at a future date.

5.9.3 Action research implications

Table 29 suggests how the findings may be important for policy, practice, theory, and subsequent research.

Table 29. Action research implications based on the findings

Findings	Implications
The implementation of Sustainable paddy cultivation (SPC) covering an area of 65.1 ha, involving 184 farmers (10 farmer groups) in 7 villages in the downstream area of the Rejoso Watershed. From 65.1 ha, 35.9 ha were planted in harmonized planting calendar, involving 110 farmers, 5 farmer groups in 2 villages.	Local government regulations, policies, and programs that support the implementation of SPC need to be encouraged so that Rejoso Watershed conservation takes place massively and measurably.
SPC improved paddy quantity and quality but there is no differentiation on the price for healthy rice. SPC has the potential to produce 32% higher grain, has 123% higher net profit, emits 36% less greenhouse gases, and uses water 15% more efficiently than conventional practices.	Farmer groups to build partnerships with the private sector for the marketing of grain at a more stable and transparent price.
Facilitation and strengthening the capacity of farmers and farmer groups to increase farmers' ability to adopt SPC is the most needed support. Other supports needed are access to agricultural machinery and access to finance.	The role of extension for the most important commodity in Indonesia, paddy is still significant. Availability of more lending platforms in favour of smallholders.

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CHAPTER 6
PROPERLY CONSTRUCTED COMMUNITY WELLS FOR WATER RESOURCE EFFICIENCY

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6.1 Profile of community well management in Pasuruan

The widespread use of poorly-designed, poorly-managed artesian wells that are left to flow 24/7 for both agricultural and domestic uses is common in the downstream areas of the Rejoso Watershed, particularly in the two sub-districts, Winongan and Gondang Wetan (Figure 33). In 2019, around 600 artesian wells were located in the Rejoso Watershed downstream areas. Almost all of them were drilled using conventional techniques.

Therefore, changing the community's behaviour in consuming groundwater extracted from the artesian wells to improve water use efficiency is one of the goals of the Rejoso Kita program. It is achieved by introducing two main programs related to sustainable paddy

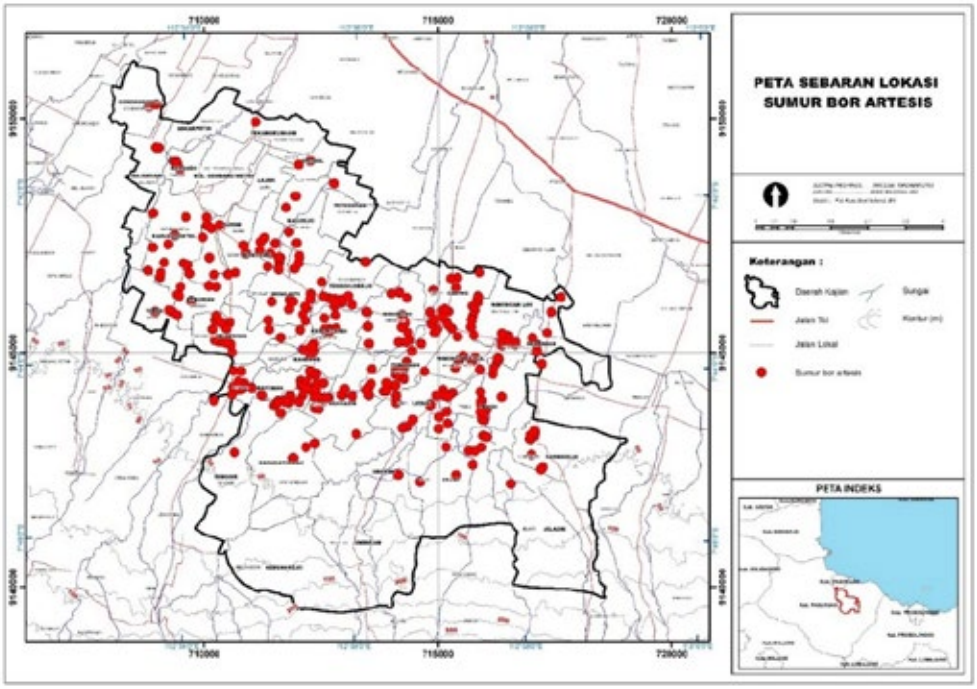

Figure 33. Distribution of massive artesian wells in two sub districts

cultivation (Section 4 above) and properly-constructed artesian wells by farmers and other stakeholders.

Properly-constructed wells are characterised by the following: (a) setting pipes to the bottom of the well to prevent blockages resulting from the collapse of the borehole wall; (b) strengthening the pipes through the use of cement casting; and (c) the installation of a water valve to control water flow (e.g., closed when not in use) (Figure 34).

6.2 Policy and regulations relevant to community well management and water resource extraction in Indonesia and East Java.

The overarching legal framework for managing water resources in Indonesia is Law No. 17/2019 on Water Resources, enacted on 17 October 2019 to replace a previous law, Law No. 11 of 1974 on Irrigation.

Some pictures of community wells (free flowing for 7/24)

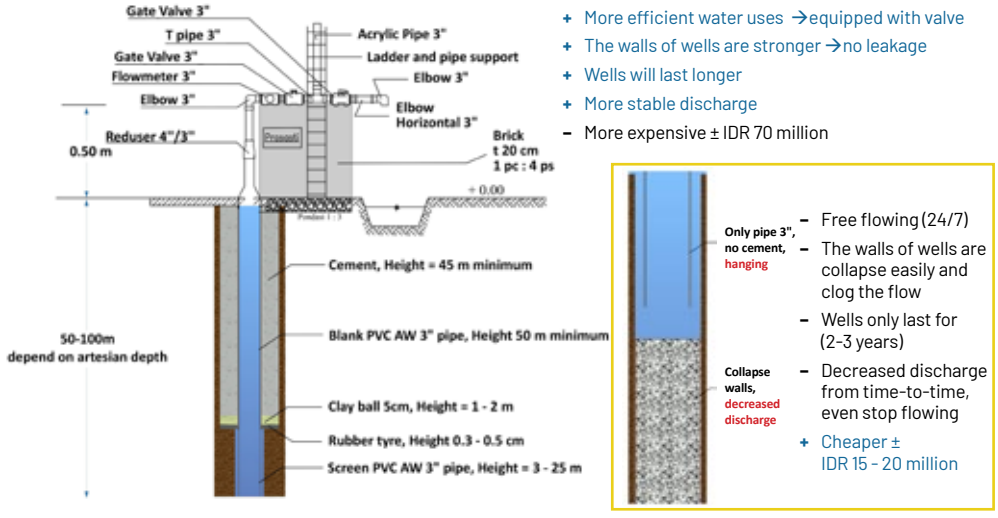

Figure 34. Properly-constructed artesian wells (left) vs common design (right) including its strengths, weaknesses, and cost

The new law aims to achieve the following aims: a) protecting and guaranteeing the right to access water; b) guaranteeing the sustainability and availability of water resources in order to provide benefits to the community fairly and equitably; c) preserving water resource functions to support sustainable development; d) establishing legal infrastructures for community participation in the supervision of the water resources, including all processes related to planning, implementation, and evaluation; e) protecting and empowering the community, including indigenous peoples, in the conservation of water resources; and f) controlling damage to the water sector through prevention, mitigation and recovery efforts.

The Law states explicitly (Chapter 22) that the model for the management of water resources will follow a river-area-based management model that considers the relationship between surface water use and groundwater by prioritizing the utilization of surface water. The chapter states that matters related to the groundwater basin boundaries are determined by the President of Indonesia (Par #6).

Regarding the prioritisation of the use of water resources, the Law (Chapter 8) specifically prioritizes the people's right to water for the following purposes: a) basic daily needs; b) irrigated agriculture; and c) for business to meet daily basic needs through the Drinking Water Supply System. Given sufficient water availability, after the first priority order, the next priority order is: a) the use of water resources to meet non-business activities in the public interest; and b) the use of water resources for other licensed business needs.

Groundwater and groundwater basin are mentioned explicitly throughout the Law, as follows:

3. Chapter 1 defines groundwater and groundwater basin.
4. Chapter 10 and 11 describes the role and authority of the central government in managing groundwater and groundwater basin.
5. Chapter 12, 13, 14, 15, and 16 describes the role and authority of local government (province and district/city levels) in managing groundwater and groundwater basin.
6. Chapter 22 describes river area management principles in water resources, including groundwater.
7. Chapter 24 and 26 describes conservation of water resources, including groundwater.
8. Chapter 29 describes groundwater utilization governance.
9. Chapter 39 describes collaboration between central government and local government on water resource utilization planning.
10. Chapter 45 relates to permits for non-commercial usage of water (domestic and agriculture) if usage is more than 25 cubic meters per month per household and/or using more than 2-inch drilling pipe.

11 Chapter 48 relates to commercial water allocation plan and water utilization zone including groundwater.

12 Chapter 54 relates to the water resources information system, including the hydrogeological conditions of groundwater basin.

13 Chapter 75 describes the application of previous regulations regarding water resources (including groundwater) concession permits already issued prior to the enactment of this Law and new permits to comply with this Law.

The sound artesian well construction program is aligned with government policy and programs related to the management of water resources, with the management of groundwater falling under the authority of the national and/or local government, as stated in Law of the Republic of Indonesia No. 17 2019 concerning water resources.

Components that are related through the issuance of groundwater permits include, among others: aquifers that are taken (only the aquifer is compressed), maximum discharge (avoiding excessive extraction and subsidence of groundwater), distance between wells (avoiding excessive extraction and subsidence of groundwater), distance between wells (avoiding excessive groundwater extraction and subsidence), and protecting groundwater protected areas (groundwater recharge areas are not allowed to be utilised for business purposes), as described by the groundwater conservation map. Commercial boreholes may only draw water from confined aquifers. This is achieved by cement grouting from the soil surface to the bottom of the impermeable layer to ensure that water from the free aquifer is not sucked in.

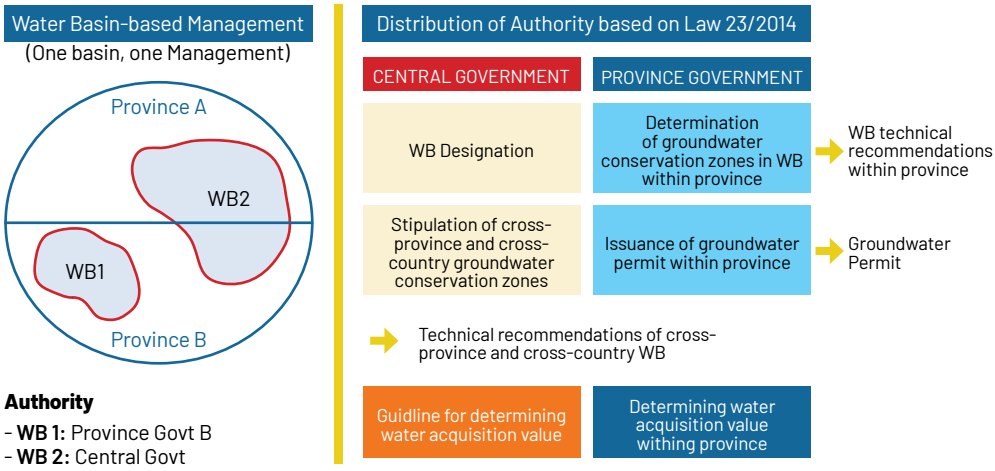

Figure 35. The concept of "One Basin, One Management" and the role of the Central and Provincial governments

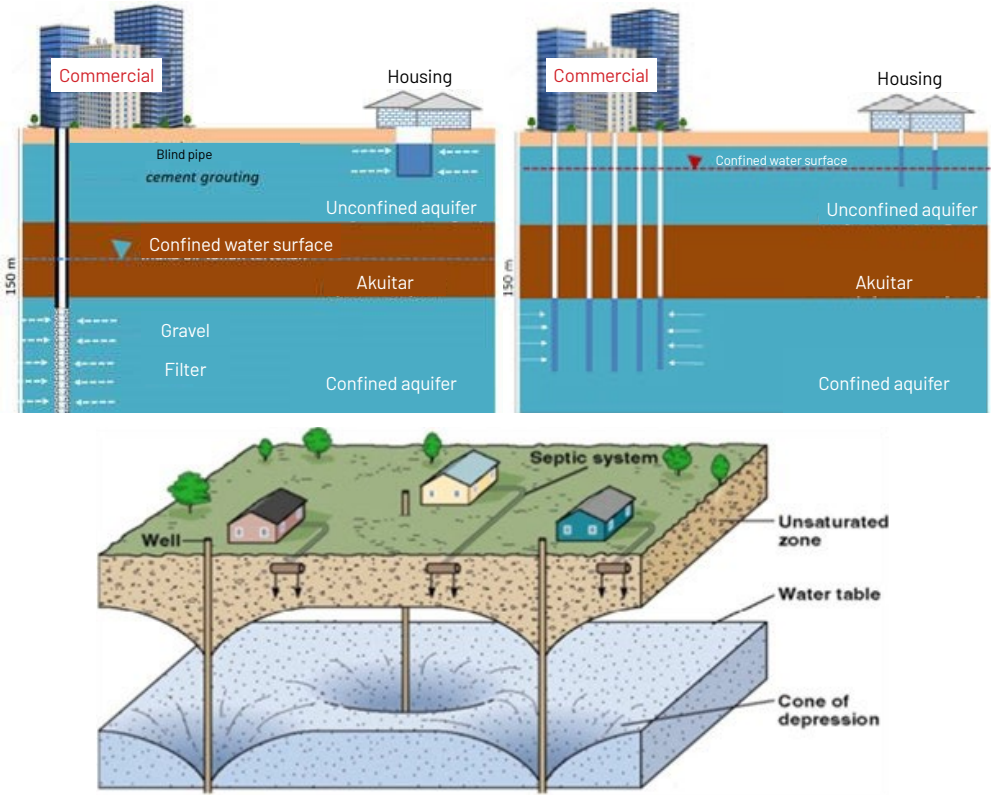

Figure 36. Groundwater conservation transect for the issuance of groundwater permit

6.3 Targeting the beneficiaries for piloting the artesian well management.

To manage water use collectively, the farmer groups appointed an *Antek* (water regulatory officer) responsible for water distribution. Therefore, our program to promote the construction of appropriately designed artesian wells and the closure of old wells is conducted in collaboration with farmer group and *Antek* for communal wells or with the owners of artesian wells for individual wells in coordination with the village head. The Rejoso Kita project is based on the consideration of the following points in the identification of farmer group or *Antek* and individuals that manage communal wells, wells designated for closure, and the location of new wells:

1. Wells ownership: There are three types of well ownership, as follows: (1) communal wells; (2) individual wells; (3) individual wells used for communal purposes. Communal wells are the focus of our current intervention, given that the targeted new wells are to be managed and monitored by the farmer groups. Type 3 (i.e. individual wells used for communal purposes) will be our second target for new well construction.


A series of focus group discussion (FGD) and key informant interviews to identify the existing status of HIPPA

2. Location of old/new wells: Private or public land, with the project prioritising the second.
3. Antek (water regulatory officer): A qualified individual should fulfill this function.
4. The wells designated for closure may be used to irrigate a significant paddy field area.
5. The location of newly constructed wells is based on strategic considerations, with the water level higher than the land level.

The Rejoso Kita planned to collaborate and work with the Water User Association (*Himpunan Petani Pemakai Air*, HIPPA), which is an association formed by and for farmers under the coordination of the district-level HIPPA administrator (Regional Regulation of Pasuruan District No. 3, 2012, concerning irrigation) to develop a sustainable artesian well management program to facilitate the improved efficiency of groundwater use. HIPPA is responsible for developing and managing irrigation systems, including water distribution to irrigate paddy fields. However, most HIPPA in the two sub-districts are inactive. As a result, the widespread use of artesian wells to irrigate paddy fields continues unabated.

6.4 Design and pilot the artesian well

6.4.1 The design of artesian well construction

Deep groundwater is water below the earth's surface, with people drilling for the water for the household, agricultural and industrial purposes.

Drilling must follow specific technical construction procedures to ensure the safety and sustainability of the well. With improper drilling and construction techniques, wells last only for two to three years at the most due to the collapse of internal walls. Loss of water pressure results from underground leakage due to flow blockages, which in turn results in a decrease in water discharges. In addition, without direct controls on the use of the regulation powers, water flows continuously and is wasted.

The procedures for the appropriate technical construction of wells include:

1. Installing pipes down to the bottom of the well to prevent blockages and leaks.
2. Casting cement around the pipe to strengthen the wall of the well.
3. Installing regulating valves to control water flow.

6.4.2 Piloting the artesian well construction

Using the agreed-upon blueprints, we constructed five new proper wells and closed four old wells (Table 30 and Figure 37). One of the five new wells was sabotaged, so it was decided to permanently close it, with the consent of the village head and chair of the farmer group.

Four constructed wells in Kebon Candi, Lebak (Ketonggo dan Kecik hamlets) and Penataan villages

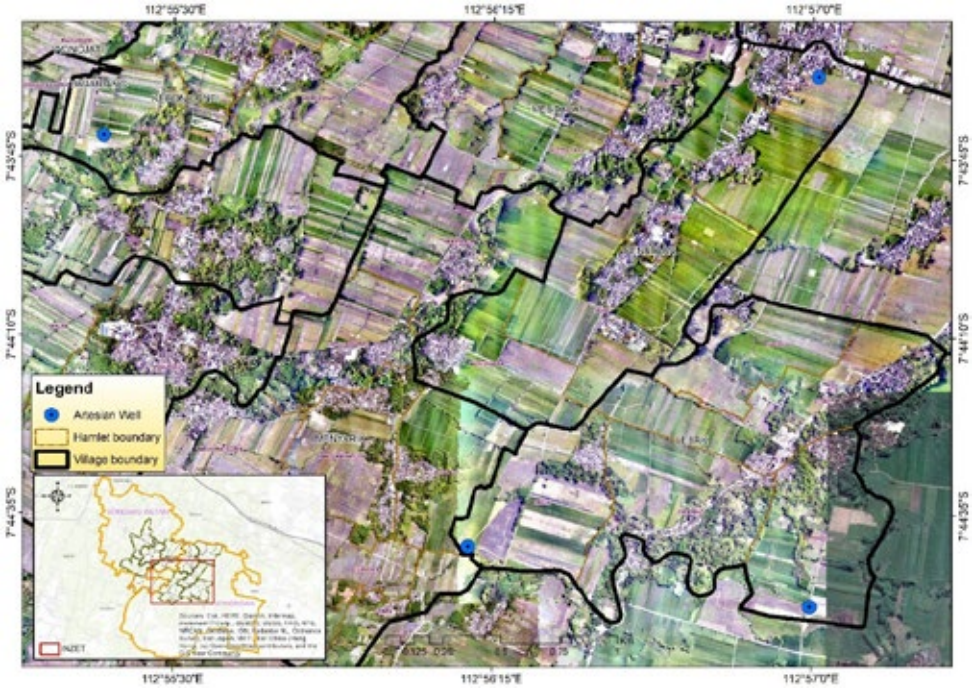

Figure 37. Location of the four constructed wells

Table 30. Five new proper wells and 4 closed old wells

No.	Village	Hamlet	Date of valve installation	# of closed wells	Total discharge of closed wells (l/s)	Note
1	Kebon Candi	Buyutan	Nov 29, 2020	2	5	
2	Wonosari	Ngepreng	Dec 12, 2020	-	10	Sabotaged
3	Lebak	Kecik	Jul 6, 2021	1	1.1	
4	Lebak	Ketonggo	Aug 11, 2021	1	11	
5	Penataan	Penataan	Sep 17, 2021	-	-	

A well in Wonosari village that sabotaged by the communities

Pictures from the construction process

6.5 Participatory monitoring of the constructed wells

6.5.1 Participatory monitoring system for the well management

The closure of old wells and the construction of new ones is intended not only to achieve a certain targeted level of water use efficiency through the use of appropriate artesian well design and the management of water valves but, more importantly, to transform community behaviour in the use of groundwater.

Subsequently, it is hoped that community members will adopt the appropriate design of the artesian well and valve management practices introduced through the project. Accordingly, we integrated the stages of the artesian well construction process with components to raise awareness on these matters. The project produced a guideline related to the monitoring of artesian wells and irrigation channels monitoring that was shared with participants during training sessions related to the monitoring of wells.[1]

1 http://apps.worldagroforestry.org/region/sea/publications/detail?pubID=4690

Table 31. Parameters for wells and irrigation channels monitoring

	Amount of water	Irrigation channels	Valve management	Wells
Indicators	Stability of well discharge	• Maintained irrigation channels (free from grass and trash) • Good water supply in irrigation channels	Recorded period of closing valve	Good condition of wells
Method	Wells discharge measurement, 3 replications	• Irrigation channels observation • Measurement of discharge in irrigation channels, 3 replications	Record the time to open and close the valve	Wells observation (completeness and condition of the valve, gate, pressure head, etc)
Frequencies	Once a week	Once a week	Daily recording	Once a month
Responsible person	Farmer group representative with facilitation from Rejoso Kita	Farmer group representative with facilitation from Rejoso Kita	Farmer group representative with facilitation from Rejoso Kita	Farmer group representative with facilitation from Rejoso Kita

Table 31 outlines the indicators, methods, frequency, and responsible person for the monitoring of the constructed artesian wells and irrigation channels. The Rejoso Kita project introduced these to the community members responsible for the maintenance of the constructed wells and the monitoring of the discharge of the wells and irrigation channels.

6.5.2 Monitoring of the constructed wells

The Rejoso Kita project continues to monitor levels of water efficiency in the case of the four new properly constructed wells based on a participatory approach. The main challenge in implementing the participatory approach to well management is to change farmer behaviour to prevent the inefficient use of water and to promote water efficiency through intensive awareness-raising and facilitation. After about 1.5 years of piloting, we have reached an estimated level of water efficiency of 14.3 l/s. The calculation is based on the application of the manual recording approach (discharge measurement and period of closed valve). Water efficiency calculation is based on participatory and manual recording approaches whose results may differ from the calculation based on the flow meter reading approach. Both methods are accurate, with strengths and weaknesses for each approach (Table 32). The detailed monthly monitoring of water efficiency is presented in Table 33.

Table 32. Strengths and weaknesses of the applied methods

Methods	Strengths	Weaknesses
Based on flow meter reading	Simple calculation	Missing certain l/s due to stuck flow meter reading
Based on manual recording	Represent stuck flow meter reading due to gravel clogged.	Step-by-step calculation

Table 33. Water efficiency of the four new proper constructed wells

Month	Buyutan, Kebon Candi			Kecik, Lebak			Ketonggo, lebak			Penataan, Penataan			Cum. water efficiency, l/s
	Disc. of old well, l/s	Effective disc. of new well, l/s	Efficiency, l/s	Disc. of old well, l/s	Effective disc. of new well, l/s	Efficiency, l/s	Disc. of old well, l/s	Effective disc. of new well, l/s	Efficiency, l/s	Disc. of old well, l/s	Effective disc. of new well, l/s	Efficiency, l/s	
Feb 2021	5	11.5	(0.50)										(0.50)
Mar 2021	5	12.3	(0.05)										(0.56)
Apr 2021	5	12.2	(0.05)										(0.61)
May 2021	5	11.3	(0.02)										(0.62)
June 2021	5	5.1	0.05										(0.58)
July 2021	5	4.8	0.12	1.1	4.9	(0.06)							(0.52)
Aug 2021	5	5.4	0.11	1.1	5.5	(0.20)	11	10.5	0.15				(0.46)
Sep 2021	5	6.6	0.08	1.1	2.8	(0.02)	11	8.0	0.60	7	4.40	0.21	0.42
Oct 2021	5	3.5	0.24	1.1	1.3	0.07	11	8.5	0.58	7	1.75	0.58	1.89
Nov 2021	5	3.8	0.24	1.1	0.7	0.08	11	3.1	0.77	7	1.95	0.57	3.55
Dec 2021	5	3.2	0.28	1.1	2.1	0.01	11	2.5	0.85	7	4.25	0.51	5.20
Jan 2022	5	6.3	(0.05)	1.1	1.7	0.05	11	6.6	0.62	7	2.36	0.50	6.33
Feb 2022	5	4.9	0.01	1.1	1.1	0.07	11	4.4	0.67	7	0.79	0.53	7.62
Mar 2022	5	6.8	(0.08)	1.1	0.8	0.08	11	1.8	0.87	7	0.28	0.59	9.08
Apr 2022	5	6.2	0.14	1.1	1.8	0.04	11	2.2	0.85	7	0.10	0.57	10.69
May 2022	5	3.0	0.29	1.1	1.0	0.08	11	0.8	0.89	7	0.11	0.59	12.54
June 2022	5	3.4	0.27	1.1	0.8	0.08	11	1.4	0.87	7	0.11	0.57	14.33

6.6 Water balance analysis in Pasuruan downstream villages

To ensure the efficient and sufficient distribution of water, it is necessary to conduct a water balance analysis. This type of analysis must be conducted based on an understanding of locations with water shortages and suplus, thus enabling the design of a pro-poor water trading scheme. Villages with surplus supply must ensure efficient water use so that their surpluses can be channeled to villages that experience shortages, which will pay the supplying village for this service. Thus, we analyzed water supply demand on the basis of a hydrogeological approach. The analysis was conducted in two sub-districts (Gondang Wetan and Winongan), with the following steps:

1. The identification of villages/ hamlets with water surpluses and shortages, maps of the area, and a list of priorities of villages/hamlets experiencing water shortages.
2. Analysis of water supply-demand based on a hydrogeological approach (Supply: precipitation index, drinking water infrastructure distribution, groundwater potential based on geology-hydrogeology, and current artesian well distribution; demand: agriculture, domestic, industry, etc).
3. Recommendations on balancing water supply and demand at the sub-district/village levels from the perspective of community-based infrastructure and with socio-economic approaches, references to successful case studies, and village-level regulations (PerDes) relevant to the project.

The study yielded the following findings:

1. Based on the precipitation index and drinking water infrastructure distribution, all villages in the two sub-districts are categorized as experiencing water shortages, although all have potential groundwater. Thus, water demand can be met from existing groundwater using the current distribution of artesian wells (Figure 38).
2. The water demand for domestic uses (60%) is much higher than the water demand for agricultural uses (1%) (Figure 39).
3. Only 14% of water flowing from current artesian wells is utilised, indicating a very high level of inefficiency in groundwater use.
4. Villages with water shortage: Tebas, Bajangan, Gondangrejo, Rangggeh, Sekarputih, Gondangwetan, Pekakungan, Lajuk, Kalirejo, Grogol, and Pateguhan (Gondang Wetan sub-district) and Umbulan, Kedungrejo, Sidepan, Sumberejo, Jeladri, Karangtengah, Sruwi, Minggir, and Winongan Lor (Winongan sub-district).
5. The study recommended distributing water from the existing artesian well with discharges of 5 – 20 l/s to villages with water shortage (i.e. Winongan Lor, Minggir, Karangtengah, Sidepan, Sruwi, Sumberejo, Kedungrejo, Umbulan, and Jeladri) (Figure 40).

Identifying existing artesian wells with discharges of 5 – 20 l/s for distribution to the villages with water shortages will be explored for further piloting. Distribution of water from wells with discharge levels of 5 – 20 l/s to areas experiencing water shortages through the implementation of a microfinance scheme could be explored. For example, the WaterCredit Initiative® loan program provides loans to those who need access to affordable financing and expert resources to implement household water and toilet solutions.[2] Further, by considering the topography of the area, a detail engineering design (DED) for the construction of the necessary water infrastructure should be prepared.

2 https://water.org/solutions/watercredit/

With support from WaterCredit, Rejoso Kita explored the WaterCredit initiative in Rejoso. This resulted in a number of proposed solutions, as follows:

1. Innovations related to the management of the use of domestic water:
   - A financing scheme for well management: Applying water bill with adjusted rates (e.g. increasing block rates, drought/ seasonal rates, water-budget based – to be determined)
   - Capacity and institutional strengthening: The introduction of new methods for the management of wells for domestic use, including the establishment of an institution (i.e. the existing inactive village-owned corporation) to collect fees and to invest the collected revenue in infrastructure maintenance and water efficiency monitoring.
   - Behavioural change: The implementation of measures to encourage the local community to value water and to apply water-efficient behavior.
   - The long-term positive impacts: Measures to facilitate water efficiency at the landscape level covering both agriculture and domestic uses.
2. Monitor levels of water efficiency for domestic use to ensure its effiency and to establish a basis for water charges.

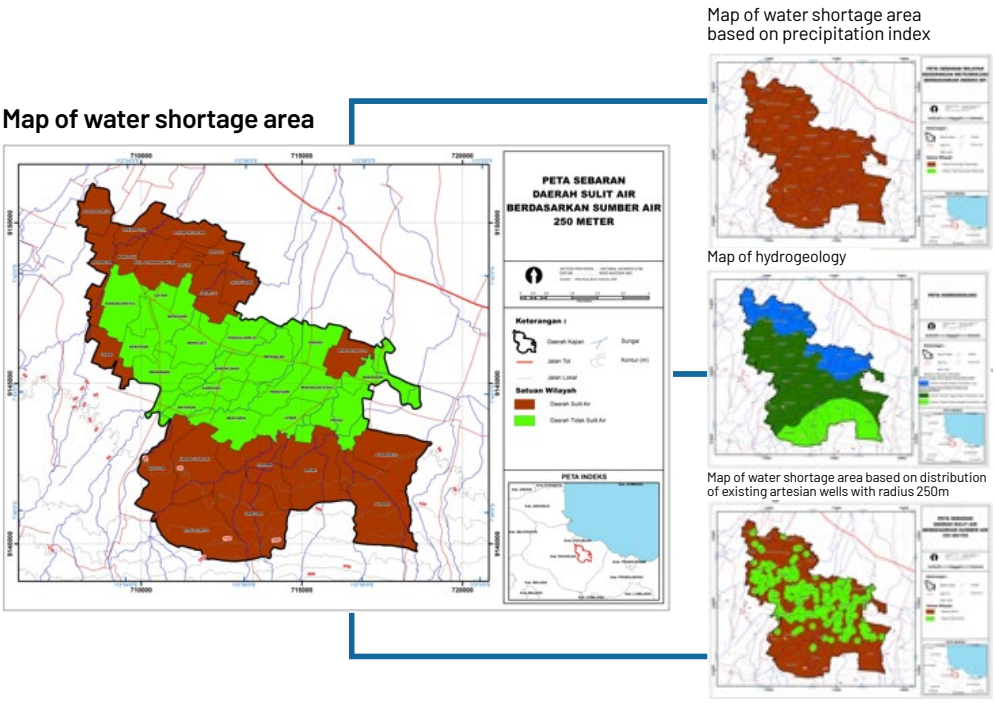

Figure 38. Map of water shortage areas based on precipitation index, SPAM distribution, ground water potential based on geology-hydrogeology, and current artesian well distribution

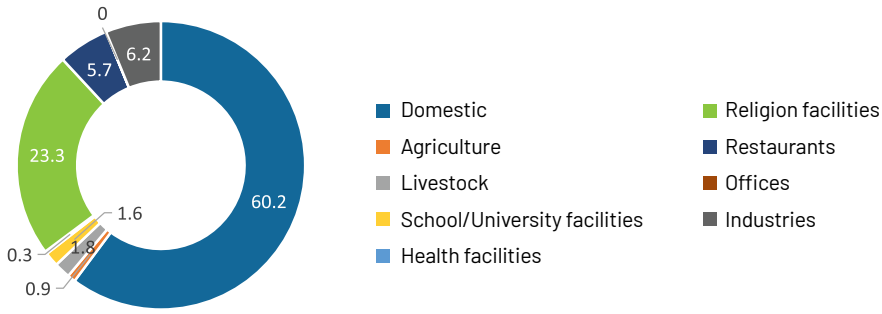

Figure 39. Distribution of water demand

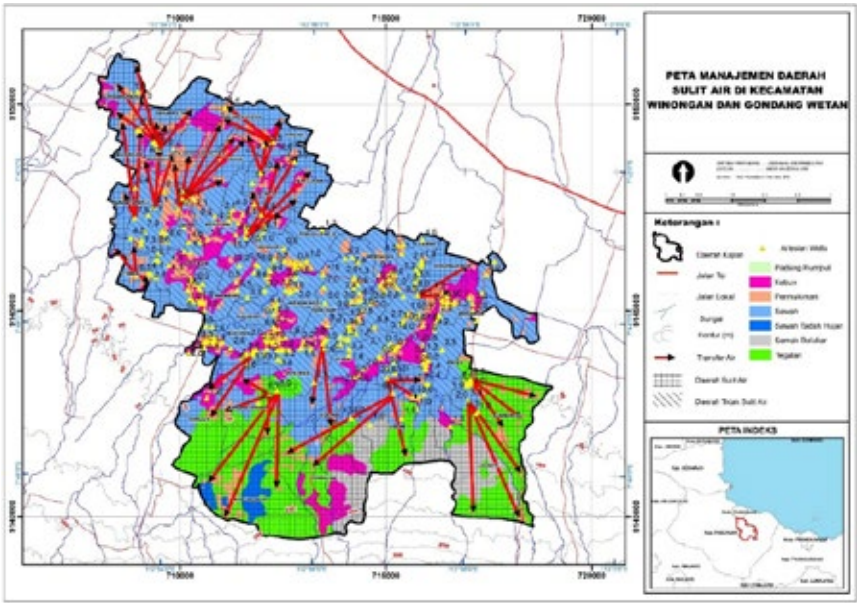

Figure 40. Map of recommendations for the distribution of water from existing artesian well with discharges of 5 – 20 l/s to villages with water shortages

6.7 Lessons in applying well management in Pasuruan

6.7.1 The management of appropriately designed wells

The Rejoso Kita project agreed that the following should be implemented in the construction of the remaining wells: (1) the use of similar drillers; (2) advocacy with local government; (3) given Danone AQUA's technical engineering expertise, it should be used to produce guidelines on the closure of old wells. However, the process of constructing new wells faced a number of challenges (Table 34) related to the identification of wells designated for closure, requests by communities for higher levels of discharge in newly constructed wells, etc. While the project identified a number of opportunities to address these challenges, processes

related to well identification, discussions with farmer and farmer groups, and other matters related to the appropriate construction of artesian wells took longer than expected.

There are three options for the management of community artesian wells, with an agreement to implement Option 1 and 2.

1. Business-as-usual: The construction of new wells and the closure of old wells
    - Principle: The level of discharge from new wells must be similar to or less than the levels from old wells, and the new wells must be constructed without agricultural conversion to paddy to avoid increased water demand from agriculture.
    - Location: The possibility of constructing and closing wells inside and outside the focus study sites (11 villages) may be considered.
    - How to measure the water efficiency: Efficiency should be measured on the basis of valve management discharge levels resulting from the closure of wells to determine if the discharge levels from the closed well is less than those from the new wells.
2. Interventions on the ongoing construction of wells by the community (without closing old well with sharing the cost between community and Rejoso Kita)
    - Principle: The construction of new wells must avoid agricultural conversion to paddy, with the project team needing to engage in intensive coordination with the drillers to avoid misperceptions among the community that this is a subsidized program.
    - Location: The possibility of conducting these interventions inside the focus study sites (11 villages) may be considered.
    - How to measure the water efficiency: Efficiency should be measured on the basis of discharge levels resulting from valve management.
3. Refining the construction of existing wells with high discharge levels (with the possibility of closing some neighbouring wells): The Rejoso Kita project will provide support for the development of infrastructure (i.e., pipes to channel water from the refined constructed well to closed neighbouring wells).
    - Identification of well to be refined and closed, possibly inside and outside the focus study sites (11 villages)
    - How to measure the water efficiency: Efficiency should be measured on the basis of discharge levels resulting from valve management.

Table 34. Challenges and opportunities toward the construction of proper artesian well

Challenges	Opportunities
• Prioritizing the public wells that serve agricultural purposes and have excessive discharges for closure/regulation will enhance water efficiency. However, the existence of such wells within the focus area of project area is limited • The status of public wells directly managed by water users or group representatives does not guarantee good management and monitoring after the completion of construction. This is due to unclear roles of each member in the water user groups.	The prioritisation of individual wells to be replaced rather than public wells
Not many individual well owners are willing to reconstruct their wells.	Explore other wells located beyond the focus of the project area (beyond 11 villages)
Local communities request higher water discharge levels from the new wells and sometimes are unwilling to manage the wells.	Facilitators negotiate and ensure that the new well discharge levels at least equivalent to those of the old wells.
There is a potential for sabotage from local communities. Intensive discussion and the involvement of the village head when negotiating and monitoring the new constructed well does not always guarantee that no sabotage will occur.	Build a monitoring system to enable the involvement of farmers. Close coordination with local government
It is difficult to integrate locations for the scaling up of SPC and water efficiency management through the well construction initiative.	Beyond the project scope, the domestic/non-agriculture water demand (more than 50%) is higher than for agricultural purposes (1%). The well management for agriculture water-demand is insignificant in increasing the overall level of water efficiency. When a water efficiency program in the agriculture sector is proposed, it is important to introduce for agricultural commodities that require lower levels of water use.
Changing the behavior of the community to reduce the inefficient use of water and to increase efficiency	Continue to facilitate and educate farmer/ water users on the importance of using water more efficiently.

6.7.2 Capacity building process

The introduction of properly-constructed artesian wells to farmers is challenging. Intensive facilitation and patience are needed, especially during the implementation of the series of focus group discussions organized to introduce the new construction techniques and to foster agreement regarding the program.

At the beginning, farmers were usually dubious regarding the new construction techniques. They were worried that the wells would explode because of the valve gate installed to control the water pressure. They also complained about the potentially reduced availability of water for their agricultural purposes. At present, farmers usually let their wells flow continuously. However, after the program facilitated

the successful construction of four new wells to replace old wells, farmers began to become convinced regarding the new construction techniques and to organize themselves to implement good well management and observation practices.

Determining water discharge levels was an interesting process, with farmers always expressing a desire for higher discharge levels, while the project could only accept levels that were the same or slightly higher than the levels of the wells designated for closure. Detailed explanations of the purpose of the project (i.e., to improve water use efficiency and to preserve their groundwater resource) enabled farmers to better understand and accept the proposed discharge levels. The selection of the location of the new wells was achieved through discussion and on the basis of mutual agreement. Opinions from experienced drillers regarding potential new well locations that would provide sufficient water discharge levels at no cost were presented to farmers.

After the construction was completed and the old well was closed, a training session was organised for farmers to implement well management techniques, with participants consisting of water-using farmers. The materials presented through the training include those to explain methods to calculate water discharge levels, to monitor the construction process, and to maintain irrigation canals. Farmers participating in the training were usually enthusiastic, expressing a strong desire to learn about good well construction and management methods. Once a month, the Rejoso Kita project team conducted a supervision visit to identify and solve problems related to well management. Farmer groups appointed a member to serve as well manager, whose tasks related to monitoring water discharge levels and to setting recording water valve opening and closing schedules.

To date, the use and management of the pilot wells have proceeded well. Most farmers say there is reduced conflict regarding water access, especially during the pre-planting land preparation processes, as they have all agreed upon a water distribution schedule among themselves. The valve gate installed as part of the new well construction process enables them to distribute water more equitably and efficiently.

Farmers are now fully aware of the purpose and benefits of the use of valve gates. During the most recent planting cycles, farmers have been observed to close the valve gate before harvesting, with some very positive effects: the grain is fuller, yields are higher, and the soil preparation process is easier during the next planting season. During the rainy season, farmers even close the valve gate for periods in excess of one month. The valve is opened to allow some water to flow for farmers to clean their tools and to bathe after working in the fields. Farmers also noted that reduced water use played a positive role in reducing the population of rats. Farmers asked for their group to make a routine schedule to maintain irrigation canals (clearing debris and blocks) so irrigation water could run smoothly and to facilitate quick and fair water distribution to all rice fields, especially during land clearing and ploughing periods.

Farmers in Gondang Wetan and Winongan sub-districts enjoy significant benefits as a result of the construction of new wells. All well managers agree that there has been a significant change in farmers' water use, with valves opened only when farmers need water for irrigation. However, it is noted that the security of the aboveground components of the well, including valve gate, water meter, and ball valve, which are locked in a specially designed iron cage, is no longer secure, with some cases of theft occurring. The introduction of cement reinforcements will make it harder for such thefts to occur.

6.7.3 Financing well management

The community members and farmers in the areas where new wells have been constructed expect all wells in the downstream areas of the Rejoso Watershed to be built following the construction techniques introduced by the Rejoso Kita project. They hope their village or higher-level local authorities will introduce regulations to control and monitor groundwater drilling. Since the cost of constructing new wells is high, farmers expect government and non-government entities to provide them with financial support. Once all wells are constructed according to the Rejoso Kita methodology, they believe the groundwater reserves in Pasuruan will remain abundant and available for future generations.

6.7.4 Action research implications

Table 35 suggest how the findings may be important for policy, practice, theory, and subsequent research.

Table 35. Action research implications based on the findings

Findings	Implications
Massive community well construction, ± 600 wells in 2019.	• The role of HIPPA and irrigation management is significant to ensure the sufficient supply of irrigation water and to control new well construction. • Farmers should be encouraged to rotate crops during dry season, with this preserving soil fertility.
Four appropriately designed pilot wells were built in 3 villages in the downstream area of the Rejoso Watershed, with their management and maintenance carried out by 4 farmer groups.	Local government regulations, policies, and programs to support good groundwater management should be encouraged so that watershed conservation is conducted systematically and on a wide basis
From the monitoring of the constructed wells, the community was able to achieve higher levels of water efficiency of 14.3 l/d over the period from January 2021 to June 2022.	
Changing the community behaviour to improve water use efficiency is challenging	Facilitation and education should be provided to farmer/water users to develop awareness of the importance of using water more efficiently should be provided through government programs.

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CHAPTER 7
THE PASURUAN MULTISTAKEHOLDER WATERSHED FORUM

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7.1 Profile and history of the Pasuruan Watershed Forum

The Pasuruan District Watershed Management Coordination Forum (FDP) was first established in 2014 on the basis of Decree of the District Head of Pasuruan No. 522/369/HK/424.013/2014. This decree was reinforced with the promulgation of Decree of the District Head of Pasuruan No. 522/474/HK/424.013/2015 in 2015, followed in 2016 by the Decree of the District Head of Pasuruan No. 522/328/HK/424.013/2016 concerning the Establishment of Management Coordination Forum for the period from 2016 to 2021. In 2018, the Decree of the District Head of Pasuruan No. 522/836/HK/424.014/2018 was promulgated to amend Decree No. 522/328/HK/424.013/2016.

According to these various instruments, the membership of the FDP consisted of representatives of various government agencies and units, with no specific mention of the participation of representatives of academic institutions and non-governmental organizations. For this reason, representatives from these sectors were not involved in the activities implemented by the FDP during these years.

During the initial period of its existence, the FDP was under the management and coordination of the Pasuruan District Forestry Agency, which provided the necessary financial and technical support for the FDP to conduct its activities. However, since all matters related to forestry affairs were later placed under the responsibility of a national-level agency, the mandate for the management of the FDP was transferred to the Pasuruan District Environmental Agency to enable the continuation of planting projects, with financial support provided by private sector operators holding Ground Water Utilization Permits (SIPA) for their operations within the boundaries of the Pasuruan District.

According to Decree of the District Head of Pasuruan No. 522/830/HK/424.013/2021 concerning the Pasuruan District Watershed Management Coordination Forum for the 2021-2026 period, the membership of the FDP should include not only representatives of district-level agencies, but also representatives of agencies at the national and subnational levels, as well as academia, the private sector, non-governmental organizations, the press, and community institutions. It was hoped that the inclusion of a broader

range of representatives would stimulate more collaborative management that would accelerate efforts to address environmental issues in Pasuruan.

7.2 Rejoso Kita's engagement in revitalizing the District Watershed Forum

During Phase 1 of the Rejoso Kita project, the project facilitated the establishment of an East Java Province multi-stakeholder watershed forum known as the Forum Peduli DAS Rejoso (FPDR), which was established on the basis of East Java Gubernatorial Decree No. 188/683/KPTS/013/2018 on November 16, 2018. To enable the forum to fulfil its intended function effectively, at the early stage of Phase 2 of the Rejoso Kita project, it organized a range of capacity building activities for the FPDR. The objectives of these capacity-building activities were to: (1) develop systems of governance for the FPDR to enable it to establish and participate effectively in public-private partnerships; (2) enable FPDR to provide technical and political support to local business entities, (3) enable FPDR to interact with national-level agencies and entities. Through this process, a work plan for the forum was developed. However, the workplan was not accompanied by the development of strategic-action and operational plans, particularly to ensure effective coordination between provincial and district level agencies.

During Rejoso Kita Phase II, the project emphasized activities to build and strengthen institutional capacities through more active engagement with the district-level watershed forum (FDP), rather than the provincial-level forum (FPDR). The rationale for this decision to focus on engagement with the district-level forum was that most of the Rejoso Kita project's activities targeted smallholder farmers, which falls under the district government's mandate and its agencies rather than their provincial-level equivalents. The project facilitated the following activities to support the FDP:

4 *Organising a radio talk show to develop the FDP's ability to engage collaboratively with a wide range of stakeholders.* The talk show aimed at strengthening the capacities of local stakeholders involved in the sustainable management of the Rejoso Watershed and developing synergies between them. The talk show presented two recipients of the Kalpataru Award (Indonesia's highest environmental award), with a discussion regarding their experiences in initiating environmental conservation projects, engaging stakeholders at various levels, and ensuring the sustainability of projects to achieve greater impacts. The two recipients of the Kalpataru Award, NP Rahadian, and Sugiarto, had been involved in activities to protect the Cidanau and Rejoso watersheds, respectively.[3]

3 https://www.youtube.com/watch?v=MBLyj6lgRU0.

A radio talk show flyer with a member of the Cidanau and Pasuruan watershed forum on October 5, 2020

4. *Organising a series of meeting with the members of Pasuruan Watershed Forum* to enable a discussion of the progress of the projects since Phase 1 (2016) and to explore potential project collaboration with the Forum and to synergize the programs of the Forum and the Rejoso Kita project as part of the project's exit strategy.

7.3 Policy and regulations relevant to the watershed forum

Among the existing national policies and regulations regarding the watershed forum and its activities are:

1. Law No. 19 of 2004 concerning Stipulation of Government Regulation in place of Law Number 1 Year 2004 concerning Amendment to Law Number 41 Year 1999 concerning Forestry;
2. Law No. 37 of 2014 concerning Soil and Water Conservation;
3. Government Regulation (PP) No. 37 of 2012 concerning Watershed Management;
4. Government Regulation (PP) No. 46 of 2017 concerning Environmental Economic Instruments;
5. Government Regulation (PP) No. 26 of 2020 concerning Forest Rehabilitation and Reclamation as a replacement for PP 76/2008;
6. Presidential Regulation No. 60 of 2021 concerning Saving National Priority Lakes;
7. Presidential Decree No. 12 of 2012 concerning the Designation of River Basin Territory;
8. Regulation of the Minister of Forestry No. P.39/Menhut-II/2009 concerning Guidelines for the Preparation of Integrated Watershed Management Plans;
9. Minister of Forestry Regulation No. P.42/Menhut-II/2009 concerning General Patterns, Standards and Criteria for Integrated Watershed Management;

10. Regulation of the Minister of Forestry No. P.57/Menhut-II/2014 concerning Criteria for Determining the Classification of Watersheds;
11. Regulation of the Minister of Forestry No. P.60/Menhut-II/2014 concerning Guidelines for Fostering Forest Farmer Groups;
12. Regulation of the Minister of Public Works and Public Housing (PUPR) No. 4/PRT/M/2015 concerning Criteria and Designation of River Basin Territory;
13. Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia No. 17/Prt/M/2017 concerning Guidelines for the Establishment of a Coordination Team for Water Resources Management at the River Basin Level;
14. Regulation of the Minister of Forestry No. P.39/Menhut-II/2019 concerning Guidelines for the Preparation of Integrated Watershed Management Plans;
15. Joint Decree of the Minister of Public Works, Minister of Forestry and Minister of Home Affairs No. 19/1984, KH. 059/KPTS-II/1984 and PU.124/KPTS/1984/1984 dated April 4, 1984, concerning Handling Soil Conservation in the Framework of Securing Priority Watersheds;
16. Decree of the Minister of Forestry No. SK. 52/Kpts-II/2001 concerning Guidelines for the Implementation of Watershed Management;
17. Decree of the Minister of Forestry No. SK. 328/Menhut-II/2009 of 2009 dated June 12, 2009 concerning Determination of Priority Watersheds (DAS) in the Framework of the Medium Term Development Plan (RPJM) 2010-2014.

7.4 Dynamic and facilitation process of FDP

In the period from December 2020 to June 2022, World Agroforestry (ICRAF) provided capacity-building support and facilitation to the FDP through a number of activities, including the following:

1. **Mapping of Stakeholders and Formation of Technical Team**

   A stakeholder mapping process was conducted on the basis of visits and discussions with community leaders, academics, and government officials whose areas of responsibility relate to environmental management. The purpose of this process was to identify individuals who could be considered for involvement in particular in technical working groups (the Technical Team) to address issues related to watershed management in Pasuruan.

   This phase took longer than expected, requiring extensive visits to individuals to provide them with lengthy presentations related to the establishment of technical teams and to determine their willingness to be part of the team.

It was also necessary to clarify the mandates and divisions of authority between the agencies responsible for river basin management under *PUPR (Balai Wilayah Sungai)*, and the agency responsible for watershed management, the Watershed Forum. It was essential to clarify this because several representatives of Pasuruan district-level agencies and non-governmental organizations were also members of the Water Resources Coordination Team (*Tim Koordinasi Sumber Daya Air*, TKPSDA), which is responsible for the management of certain rivers through the Balai Wilayah Sungai Welang – Rejoso at the national and sub-national levels.

The stakeholder mapping process was completed and resulted in the assembly of concerned stakeholders, including representatives of the media (Warta Bromo), Pasuruan Regency Environmental Unit, Pasuruan Regency Public Works and Water Resources Unit, Universitas Merdeka Pasuruan, Yayasan Sekola Konang Indonesia, Yayasan Sanggar Indonesia Hijau, Forum Pasuruan Sehat, PT. Air Bersih Jawa Timur and PT. Tirta Investama. All of these representatives were appointed as members of the Technical Team for Performance Improvement of Pasuruan Regency Watershed Management Coordination Forum through the issuance of Decree of Head of FDP No. 003/SK-FDAS/IV/2021.

2 Discussions by the Technical Team

Issues addressed by the Technical Team to strengthen FDP included the following:

1. FDP Working Area

To determine the particular areas under FDP management, which include an area of 1.474,015 km^2 and contain the following nine watersheds:

(1) Brantas Watershed;
(2) Kapasan Watershed;
(3) Kedung Larangan Watershed;
(4) Lawean Watershed;
(5) Pateman Watershed;
(6) Rejoso Watershed;
(7) Tandu Watershed;
(8) Tempuran Watershed;
(9) Welang Watershed.

2. Priority Issues

To discuss priority issues affecting the designated working areas, including the following:

(1) Critical land;
(2) Land use change;
(3) Waste management;
(4) Community economic empowerment;
(5) Communication and advocacy;
(6) Efficiency of groundwater use.

3. Stakeholders

The Technical Team conducted an inventory to identify the agencies and authorities whose mandates related to the management of the priority issues specified above. These stakeholders were invited to attend a meeting to address institutional issues related to the FDP and its role in the management of watershed management and environmental services. Following this presentation, they were canvassed to determine their willingness to participate in the FDP institutional structure.

In addition to facilitating the development of the FDP's organizational structure, the Technical Team also worked to define the tasks and authorities of each entity. These were then used to formulate the Governance of Pasuruan Regency Watershed Management Coordination Forum, Annex II of Pasuruan Decree No. 522/830/HK/424.013/2021, which forms one aspect of the legal basis for FDP to implement its program activities.

4. Developing the Governance of Soil and Water Conservation Fund

To provide members of the Technical Team with an opportunity to observe soil and water conservation activities conducted on the basis of an environmental service payment scheme, a one-day trip was organized to enable the members to visit farmers involved in the environmental service pilot project in the upstream and midstream areas of Rejoso Watershed. This project was managed by ICRAF in the period from 2016 to 2018.

The visit was conducted to facilitate the Technical Team's ability to develop concepts related to the management of soil and water conservation funds for all watersheds in Pasuruan.

The Technical Guidelines for the Governance of Soil and Water Conservation Funds were then legalized through a Decree of the Chairperson of FDP. These guidelines were then used to provide a basis for the management of the mobilization of funds to facilitate the conservation of soil and water resources. Most of these funds were derived from water-based industries in Pasuruan, either in the form of trust funds, conservation assistance mechanism (funds allocated by the beneficiaries to maintain the sustainability of their businesses and/or activities), payment for environmental services, or other legitimate non-binding funds, as determined by prevailing rules and regulations.

In addition to formulating the Technical Guidelines for the Governance of Soil and Water Conservation Funds, the Technical Team also prepared environmental service proposal templates that can be sent to the environmental service users who might be willing to pay for environmental services voluntarily.

The submission of the proposal was the first step in the process of initiating an environmental services payment scheme. It is intended that the scheme will be implemented in a number of stages, with a separate stage each for socialization, negotiation, and signing an agreement for payment of environmental services between FDP and industries that use environmental services derived from the watershed in Pasuruan.

5. Roadmap Development

The Technical Team developed a roadmap formulated as an Integrated Water Resource Management Plan (*Rencana Pengelolaan DAS terpadu*, RPDAS) to define the roles of all stakeholders and office bearers involved in the management of priority issues.

The roadmap integrates the efforts of different agencies and entities in different sectors to address priority issues following a mutually agreed-upon plan.

With the formulation of the roadmap, all stakeholders can build a common vision and commitment regarding the types of activities and interventions, division of roles, timing, and budget allocation needed to achieve the defined goals. The roadmap process involved all stakeholders relevant to watershed management in Pasuruan. It is intended to enable FDP to act as a forum through which government and non-government actors can interact to share their opinions and to develop plans to manage the activities outlined in the roadmap effectively and transparently.

The process of preparing the roadmap involved coordination with other development activity plans to ensure synergies in formulating an integrated watershed management plan. This was intended to ensure that all development plans in Pasuruan are conducted in accordance with the principles of sound integrated watershed management policies. The roadmap draws on a wide range of data and information sources to formulate effective activity plans.

Ultimately, the roadmap is intended to serve as a reference and as an expression of the commitment of all stakeholders to implement watershed

management in Pasuruan in a manner that promotes the effective management of water resources and of environmental sustainability more generally. It is intended that the roadmap should be a dynamic, evolving document, subject to ongoing evaluation and adjustments in the context of real conditions in the field to ensure that it remains relevant.

3 **Workshop**

In collaboration with ICRAF, FDP organized a workshop on integrated watershed management on February 10, 2022. This workshop resulted in two significant achievements. First, it provided a forum to describe all processes involved in program activities and their progress conducted by ICRAF since 2016. Second, it provided a means to engage the more active participation of stakeholders in watershed management in Pasuruan. The workshop was also used to launch a book on the process of the institutional facilitation of FDP.

The Pasuruan district head, the regional second assistant, and several high-ranking government officials attended the workshop. This provided an important acknowledgement of the role and significance of the FDP in establishing and developing integrated watershed management and environmental services in the district.

In his opening speech at the workshop, the district head expressed his strong support and appreciation for the establishment of the FDP. He also took the opportunity to inaugurate the FDP management team. This high-level political support from the district head create spaces for the FDP to plan and implement program activities to address the priority issues by ensuring the full support of a wide range of stakeholders from government agencies and the private sector in Pasuruan. With this support, the FDP management team will be able to establish and strengthen communication and coordination with related stakeholders to address the priority issues outlined in the roadmap.

7.5 Watershed forum engagement

Following a virtual meeting of Watershed Forum of Pasuruan/Forum DAS Pasuruan (FDP) members on December 2, 2020, a series of meetings between the FDP and district level government agencies was held in the first semester of 2021. The Rejoso Kita project provided support to FDP to:

1 Facilitate the establishment of a technical team within the watershed forum to develop the forum's strategy and work plan to enable it to fulfil its role as an intermediary in integrated

water resource management (IWRM), including in the area of payment for ecosystem services.

2. Review the organizational structure of the watershed forum.
3. Develop three documents, as follows:
    a. A proposal for an integrated water resource management (IWRM) scheme including payment for ecosystem services (PES) to be submitted to private sector operators in the downstream areas of the Rejoso and other watersheds in Pasuruan;
    b. Governance guidelines for the implementation of the IWRM schemes; and
    c. A watershed forum roadmap, including strategic and operational plans for 2022 – 2027.

During the first semester of 2021, the project provided facilitation to FDP to establish a technical team and to review the watershed forum's organizational structure. The technical team was established on March 9, 2021, consisting of a coordinator and 13 members. The decree was signed by the chair of the forum, Dr Sulistiyowati, on April 6, 2021. After the technical team was established, it conducted a series of meetings and discussions with various stakeholders at the district level (government representatives, key informants, religious figures) in the period from 1 to 12 April 2021. The objective of these meetings was to socialize the role of the watershed forum within IWRM and to gather support from the participating stakeholders.

To review the organizational structure of the FDP, a series of meetings and discussions between the technical team and members of the FDP was conducted between 7 – 8 April 2021. A new organizational structure was agreed upon, with a decree to formalize this decision to be signed by the district head. Figure 41 and Figure 42 show the organizational structure of the FDP both before and after the revitalization. With the new structure, the FDP has divisions that can run integrated water resource management (IWRM) through public-private partnership schemes involving multiple stakeholders, in line with the government policies such as UU 32/2009 on environmental protection and management. Due to the prioritization of a number of pressing local issues, the signing of the decree has taken longer than expected. For the FDP's new organizational structure, we proposed that *Badan Perencanaan Pembangunan Daerah*/BAPPEDA (Regional Planning Agency) act as the chair of the FDP, as BAPPEDA has the authority to coordinate all agencies at the district level. However, BAPPEDA suggested that the *Dinas Lingkungan Hidup Kabupaten*/DLH (district level Environmental Agency) should fulfil this role instead. After a series of intensive discussions with DLH, DLH agreed to act in this capacity.

To build the capacity of the FDP, the project facilitated a one-day field visit for the FDP members to a range of landscapes where innovations had

Signing of decree for the formation of the FDP technical team.

A series of meetings and discussions between the technical team of FDP and various stakeholders at the district level (government, key informant, religious figures) between 1 – 12 April 2021.

been implemented under Phase 1 and 2 of the project. During the field visit on June 16, 2021, a number of regional journalists involved in covering Pasuruan news also participated. Participants visited Wonokitri (upstream) and Galih (midstream) villages to meet farmers who had previously participated in payment for ecosystem service pilots. The visit concluded at Keboncandi (downstream) village, where an artesian well had been constructed to demonstrate improved water use efficiency. Dr Sulistiyowati, the former chair of the FDP, expressed her appreciation for the visit and said that the learning and experience during the visit would be beneficial in designing and developing environmental protection programs for the eight watersheds in Pasuruan district that have become the focus of the FDP.[4]

4 https://www.youtube.com/watch?v=RPQdY-NVuSc .

One day field visit of the FDP and technical team and local journalist to phase 1 and phase 2 sites.

7.6 Lessons learned in facilitating the FDP in Pasuruan

7.6.1 Facilitation and capacity building process

The process of institutional facilitation was relatively time-consuming, with a number of stages to pass through. The major stages of the process were as follows:

1 Stakeholder Mapping

Stakeholder mapping involved visiting all members of the FDP management team, community leaders, and representatives of Pasuruan district government agencies. The purpose of these visits was to discuss and explore issues related to watershed management and to identify stakeholders (government representatives, academics, non-governmental organizations, and representatives of the private sector and the media) who could be invited to participate in further discussions regarding watershed management in Pasuruan through a new multi-stakeholder arrangement.

The individuals identified through the stakeholder mapping processes were visited to establish a relationship, to introduce ICRAF institutional facilitators, to discuss matters related to watershed management, and to assess their willingness to be involved in the technical team that was to be established to formulate strategies and programs related to watershed management in Pasuruan.

2 Socialization/program sensitization

Individuals and representatives of institutions that had expressed interest and willingness in participating in the technical team were invited to a special meeting to enable them to gain a greater understanding regarding the institutional strengthening process and related issues in watershed management. In particular, the

meeting stressed the importance of payment for environmental service schemes as a strategy to preserve forest areas by establishing social forestry programs. These programs are intended to provide incentives to farmers to maintain and improve the quality and quantity of natural resources, especially water resources.

The meeting also addressed the differences between watershed management and river basin management. It was noted that river areas can include many watersheds, with the responsibility for management river basins shared by a range of national and sub-national agencies.

The River Basin Water Resources Management Coordination Team (TKPSDA) was established by the Regulation of the Minister of Public Works and Public Housing of the Republic of Indonesia No. 17/Prt/M/2017 concerning Guidelines for the Establishment of a Water Resources Management Coordination Team at the River Basin Level. The TKPSDA is a forum established to enable stakeholders to formalize plans, with half of its membership consisting of government representatives and the other half consisting of representatives of community organizations and private sector organizations.

The legal basis for the establishment of a watershed forum Government Regulation (PP) No. 37 of 2012 concerning Watershed Management. Membership in this forum is open to all stakeholders willing to participate in issues related to the management of watersheds.

To ensure the effective management of watersheds, it is crucial to establish a solid basis for coordination and cooperation between stakeholders based on a mutually agreed upon plan and a recognition of the authorities in capacities of each of the stakeholders involved in the process.

3 Technical Team

The FDP Performance Improvement Technical Team consists of representatives of institutions that have expressed their willingness to participate in the team to address issues to enable the FDP to build and develop integrated watershed management and environmental services programs in Pasuruan. The Technical Team was established on the basis of Decree of the Head of FDP and consists of representatives of Pasuruan district government agencies, academics, non-governmental organizations, the private sector, and the media.

As a result of meetings and discussions conducted by the Technical Team, several documents related to FDP institutional strengthening have been produced, including the following:

a. Pasuruan District Head Decree on FDP Organizational Structure, Tasks and Authorities (job description) of each member;

b. Technical Guideline for Governance of Land and Water Conservation Funds;
c. Template of proposals for payment for environmental services programs;
d. Roadmap;
e. Pasuruan District Head Decree on Environmental Economic Instruments.

To ensure the technical team's full understanding of the issues covered in these four draft documents, ICRAF facilitators gave presentations on what has been achieved elsewhere in Indonesia as examples and references. In this process, it was stated clearly that each region faces its own particular challenges. Collectively, the Technical Team has a high degree of knowledge regarding the Pasuruan community's current environmental, social, and economic conditions. Thus, it is the appropriate forum to develop integrated watershed management and environmental services.

It took a relatively long time to determine which of the district level government agencies would serve as the FDP chair. It was expected that Bappeda would initially fill this function, given its broad functions and authority. However, Bappeda stated that it would not be able to serve in this capacity due to changes in Bappeda's defined tasks and functions following newly enacted laws and regulations.

On the other hand, the Head of Public Works, Water Resources and Spatial Planning (PUSDA-TR) felt he did not have sufficient authority to coordinate stakeholders, especially the related government units. Similarly, the Head of the Pasuruan District Environmental Office also refused to serve as the FDP Chair, arguing that matters related to forestry no longer fell under the mandate of the district government. In this regard, he appeared to believe that the main function of the FDP was to address issues related to forestry.

To resolve this issue, the project team approached the Second Regional Secretary of Pasuruan District to seek guidance and inputs. The Secretary promised to conduct a special meeting with all head of Pasuruan district government units. However, this meeting was never scheduled.

Given the lack of resolution to this issue, it was decided to approach the Head of the Pasuruan Environmental Office. After the Technical Team made it clear that the FDP was not established to focus exclusively on matters related to forestry, but also on soil and water conservation and on social and economic issues affecting members of the community living in the watersheds, the Head of the Environmental Office agreed to act as the FDP Chair. Following this decision, the process of formalizing the establishment of the FDP by the Pasuruan district head resumed.

7.6.2 Governance and institution of watershed forum

From the time of the establishment of the FDP in 2014 until the time that its structure was amended in 2018 (Second Amendment to Pasuruan District Head Decree No.: 522/328/HK/424.013/2016 concerning the Establishment of the Pasuruan Regency Watershed Management Coordination Forum for

the 2016-2021 period), its membership has been dominated by representatives from Pasuruan district-level government agencies. While the amendment refers to representatives of the private sector (i.e., represented by CSR Forum), there is no specific mention of the names of either these private sector representatives or non-government and/or environmental advocacy organizations. Given this lack, it is challenging to ensure their active involvement and participation in FDP activities, whether related to conservation or to the social and economic empowerment of the community.

Figure 41 shows the organizational structure of FDP following the promulgation of Pasuruan District Head Decree No. 522/328/HK/424.013/2016 concerning the Establishment of the Pasuruan Regency Watershed Management Coordination Forum for the 2016-2021 period:

In reviewing the FDP's organizational structure, the Technical Team was encouraged to give consideration to the involvement of a broad range of stakeholders, based on a recognition that addressing issues related to watershed management in Pasuruan would not be possible with the exclusive involvement of government units, especially when a wide range of stakeholders is not involved in the development of program plans and implementation. The complex environmental issues affecting a watershed may have their roots in lack of knowledge and neglect of environmental sustainability by the people living in the watershed, government policies, and the manner in which businesses conduct their operational activities.

The reasons for the involvement of different stakeholders in the management of the FDP vary between the different groups:

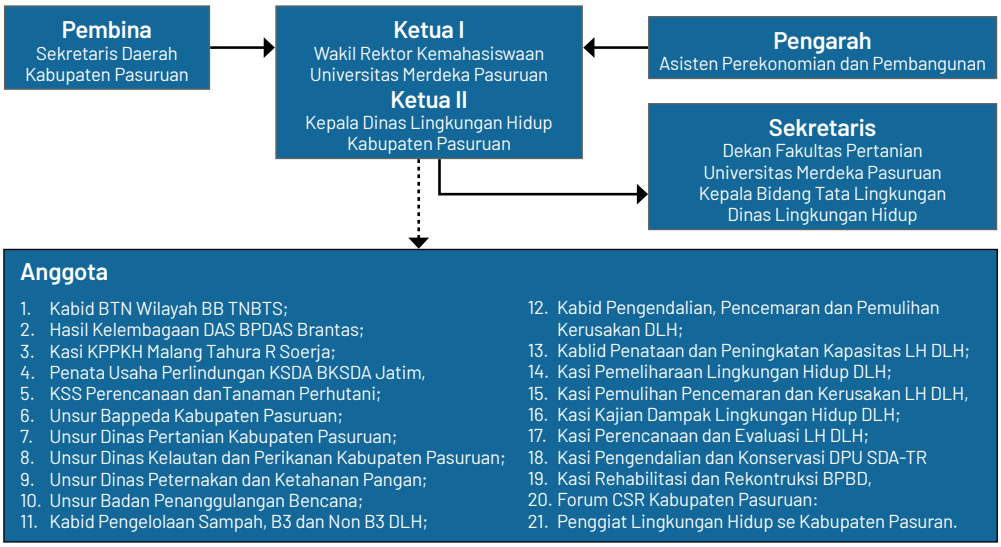

Figure 41. Organizational Structure of the Pasuruan Watershed Forum (FDP): before the revitalization

- *Government Representatives*: Their core duties, functions, and authorities are related to the agreed-upon priority issues.
- *Private Sector Operators*: Priority is given to private sector operations that use water as a primary or significant input for production.
- *Non-Governmental Organizations*: These are involved due to their engagement in various social and economic empowerment affecting the community, especially empowerment activities related to conservation, agriculture, and health.
- *Media*: Priority is given to representatives of the media frequently report on environmental issues.

As a result of this process of identifying stakeholders, the Technical Team was able to develop a proposed revision to the previous FDP organizational structure. The proposed revision is outlined in Figure 42.

7.6.3 Policy implications

During the socialization of the documents produced by the Technical Team, participating private sector operators focused on issues related to the rules and regulations that formed the legal basis for FDPs activities.

In order to be effective, the integrated watershed management and environmental service scheme needs to be integrated and mainstreamed into the regional mid-term development plan (*Rencana Pembangunan Jangka Menengah Daerah*, RPJMD). A decree by the Pasuruan District Head is urgently needed to regulate environmental economic instruments.

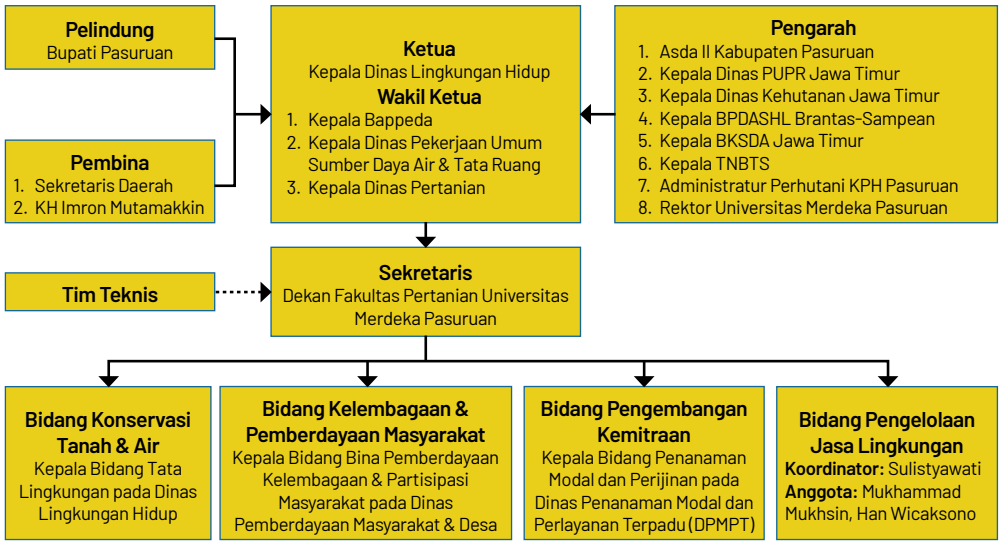

Figure 42. Organizational Structure of the Pasuruan Watershed Forum (FDP): after the revitalization

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CHAPTER 8
KNOWLEDGE MANAGEMENT, COMMUNICATION, AND OUTREACH

Aunul Fauzi

8.1 Introduction

Knowledge management is the process by which a project captures and shares its knowledge to make it accessible and to ensure that it provides value to all project stakeholders and beneficiaries.

In the case of the Rejoso Kita project, knowledge includes both explicit knowledge (already possessed, documented, and stored) and the implicit knowledge (experiences, skills, comprehension, or know-how information) possessed by the project stakeholders and beneficiaries.

Of equal importance, both explicit and implicit knowledge needs to be identified, retrieved, gathered, collected, and organized to ensure its clarity and completeness. In the context of knowledge management, this process may be referred to as *capturing knowledge*. Following this process, the next process is *knowledge sharing*, which refers to producing, communicating, exchanging, and socializing the knowledge amongst the targeted stakeholders and beneficiaries. This chapter discusses project communication and outreach at this level.

8.2 Knowledge management and communication activities under Rejoso Kita Phase 2

To address the ecological and socio-economic issues identified in the Rejoso Watershed, a framework for strategic collaboration between relevant stakeholders was established during the first phase of the project (2016-2019). A similar approach was applied during the project's second phase, which commenced in 2019 and ended in 2022. Stakeholders from government and non-government entities, academia, press, and business sectors were invited to join and participate in an alliance to preserve Rejoso Watershed (Table 36). This strategy was adopted on the basis of the recognition that a multistakeholder approach is essential to develop and apply integrated watershed management. The World Agroforestry Centre (ICRAF) led the coordination and implementation of the project during the second phase starting in 2019. The expertise and experience (implicit and explicit knowledge) of each stakeholder group enabled the project to formulate plans, strategies, and recommendations to implement sustainable watershed management.

In the case of the Rejoso Kita project, knowledge management consists of two components, as follows: (1) capturing the tacit and explicit knowledge stored and possessed by all project stakeholders and beneficiaries; and (2) sharing the knowledge among project stakeholders and beneficiaries.

The first component, capturing knowledge, commenced with the identification of the institutions and individuals with relevant knowledge. This process enabled the project to draw a clear picture of what to expect and were gaps existed related to knowledge management to enable it to achieve its goals.

Table 36. List of Stakeholders and Beneficiaries with Type of Knowledge Possessed

Stakeholders and Beneficiaries	Specific Actors	Types of Knowledge Possessed
Government entities	Government of Pasuruan District	Policies, regulations, and standard operating procedures related to general District governance.
	Pasuruan Planning Agency (BAPPEDA)	Research reports, proposals of policies or regulations related to environment related management and utilization.
	Pasuruan District Environmental Office	Regulations and standard operating procedures related to specific to watershed management.
	Pasuruan District Agricultural Office	Regulations and standard operating procedures related to specific agricultural activities.
	Pasuruan District Housing and General Work Office	Regulations and standard operating procedures specific to irrigation management.
	TKPSDA (Tim Koordinasi Pengelolaan Sumber Daya Air) Welang Rejoso, Pasuruan	Regulations and standard operating procedures related to the management and preservation of Welang-Rejoso rivers.
	BPDASHL (Balai Pengelolaan Daerah Aliran Sungai dan Hutan Lindung) Brantas-Sampean	Regulations and standard operating procedures related to the management and preservation Brantas -Sampean watershed and protection forests.
	Balai Besar Wilayah Sungai Brantas	Regulations and standard operating procedures related to the management and preservation of Brantas River.
	Government of Sub-Districts (Winongan and Gondang Wetan)	Regulations and standard operating procedures for agriculture-related issues.
	Government of Villages and sub-villages (11 villages in two sub-districts)	Regulations and standard operating procedures for agriculture-related issues.

Stakeholders and Beneficiaries	Specific Actors	Types of Knowledge Possessed
Non-government organizations	World Agroforestry (ICRAF)	Research results, expertise, and experience related to various environmental management issues (water, soil, landscape, agroforestry, people, environmental service).
	Forum Koordinasi Pengelolaan DAS Kabupaten Pasuruan (FDP)	Roadmap and standard operating procedures for coordinating the management and preservation of watersheds in Pasuruan District.
	Yayasan Sanggar Indonesia Hijau	Experience in implementing environment protection projects.
	Yayasan Sekola Konang Indonesia	Experience in implementing environment protection projects.
	Forum Pasuruan Sehat	Experience in implementing environment protection projects.
	Rekonvasi Bhumi – Cidanau Banten	Experience in implementing environment protection projects.
	Danone Ecosysteme	Expertise in supervising and supporting project implementation.
	Rabo Foundation	Expertise in facilitating and supporting non-government organization for financial literacy and support.
	KOSPIN Tekun	Expertise in managing or operating cooperation for community and farmers.
	KMM – Beras Orisa	Expertise in connecting rice farmers with markets.
Academic	Universitas Merdeka, Pasuruan	Research results and learning materials for environmental issues.
	University of Brawijaya, Malang	Research results and learning materials for soil science.
	Gadjah Mada University, Yogyakarta	Research results on issues related to the utilization of ground water in Pasuruan District.
	Montpellier University, Paris, French	Research results related to water use in Pasuruan groundwater basin.
Business Sectors	PT Tirta Investama (Aqua Danone)	Experience and expertise in implementing sustainable environmental conservation projects.
	PT. Air Bersih Jawa Timur	Experience and expertise in running water-related business.
Individuals working on environment related issues	Ibu Kholifah of PPAH (Pos Pelayanan Agens Hayati) Tani Makmur of Beji, Pasuruan, East Java	Experience and expertise in producing and marketing organic fertilizer and biopesticides.

Stakeholders and Beneficiaries	Specific Actors	Types of Knowledge Possessed
Media	Radar Bromo	Experience in producing and broadcasting print and online environmental news for general audiences (community).
	Radio Suara Pasuruan	Experience in producing and broadcasting radio on environmental news for general audiences (community).
Community	General Community	Ideas, perceptions, opinions, way of thinking, insights, skills, and expertise related to general environmental issues and topics.
	Upstream Famers	Ideas, perceptions, opinions, way of thinking, insights, skills, and expertise related to agriculture practice and conservation of environmental resources.
	Midstream Farmers	Ideas, perceptions, opinions, way of thinking, insights, skills, and expertise related to agroforestry and conservation of environmental resources.
	Downstream Farmers	Ideas, perceptions, opinions, way of thinking, insights, skills, and expertise related to paddy cultivation and irrigation for agricultures.

The second component, sharing the knowledge, was conducted on the basis of a performed following a communication plan consisting of four main elements (i.e., objectives, messages, audiences, and channels or tools), as shown in Figure 43.

A project communication plan is intended to facilitate achieving the project's goals, research objectives, community development impacts, and sustainability. In the case of the Rejoso Kita project, these goals will be achieved through the active dissemination of information related to the project's activities and impacts among the target audiences through multifaceted specific messages delivered through various communication channels.

The process by which each communication product is prepared will involve the following steps:

1. COLLECT (finding materials: terms of reference, minutes of meetings, presentations, links, documents, research reports, interviews, photos, videos, etc.)
2. PRODUCE (designing communication products: composing texts, editing pictures, making infographics, creating videos)
3. DISTRIBUTE (using different channels to broadcast, both online and offline)
4. MONEV (monitoring & evaluating communication activities)

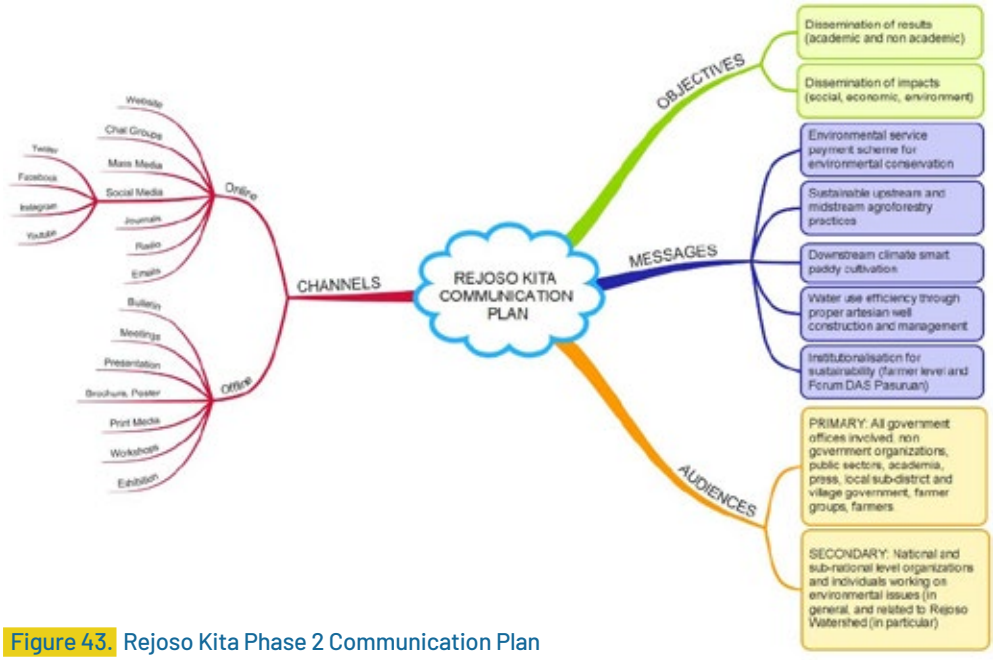

Figure 43. Rejoso Kita Phase 2 Communication Plan

The fourth step is to observe and measure the success (or failure) of the communication activities in achieving the project's goals, as determined through a monitoring and evaluation process that involves quantitative and qualitative indicators, as specified in Table 37.

Table 37. Type of media channels, messages, and achievements

CHANNELS	MESSAGES	ACHIEVEMENT
ONLINE		
Website	Basic information related to the project (supporting donors, project implementor and partners, etc.), project plan, activities, and updates.	One website was created, embedded to ICRAF headquarters' website.
Chat Groups	Project coordination and updates	Three WhatsApp groups were established (for coordination among Rejoso Kita implementing team, Rejoso Kita plus Danone Aqua, and for institutional facilitation work). Two other WhatsApp groups were established to communicate specific project activities (well construction and rice cultivation). One WhatsApp group was established by downstream rice farmers themselves to discuss project activities and related issues.

CHANNELS	MESSAGES	ACHIEVEMENT
Online News	Project activities, key messages, achievement	At least five major Rejoso Kita events were covered by regional online and print journalists, as follows: 1) second phase project launching, 2) demonstration plot harvesting day, and 3) media gathering in commemoration of World Water Day, 4) media visit to project sites, and 5) workshop on sustainable water resource management. The total number of online and offline appearances featuring Rejoso Kita in the news for these events was 66.
Radio	Specific issues related to sustainable rice cultivation, water use efficiency, agriculture financing, and institutional strengthening in environmental management	This was achieved through a collaboration between Rejoso Kita and Radio Suara Pasuruan, as a result of which the following outputs were produced: 1) Six 'Tahukah Anda' series, a 60 second public service announcement on environmental issues related to matters such as water, rain, and flood events in Pasuruan, aired at least four times a day during the collaboration period. 2) Eight Radio Talk show presenting representatives of academia, government, non government organizations, press, public sectors, and farmers to talk about issues related to the Rejoso Kita project, such as sustainable rice cultivation, efficient water use, financing for farmers, and institutional strengthening.
Facebook	Updates of project activities and important relevant values or messages.	To date, Rejoso Kita Facebook page has more than 3900 friends. The number of impressions (like or thumb) for each posting varies from 3 to 60, with an average of around 10 comments or less).
Twitter	Updates of project activities and important relevant values of messages.	Rejoso Kita Twitter account follows 94 accounts, but has only 55 followers and 399 tweets.
Instagram	Updates of project activities and important relevant project values or messages.	There have been 666 postings on the Rejoso Kita Instagram account, which has 354 followers to date.
YouTube	General information regarding the project, know how, knowledge, and specific project activities (well construction, well monitoring, sustainable rice cultivation, payment for environmental services)	Rejoso Kita YouTube channel has 201 subscribers and presents 41 videos with the number of views ranging from 12 to 552 (counting Phase 2 project videos only).
Journals	Results of demonstration plot trials, water efficiency targets, environmental service bidding process.	At least three articles have been published in reputable international journals.

CHANNELS	MESSAGES	ACHIEVEMENT
Emails	Invitations for meetings or discussions on specific issues.	Emails are used for formal communication with project donors and stakeholders especially during preparation and follow up of certain project events.
OFFLINE		
Bulletin	Updates on project activities and achievements and stories from the field.	To date, six 4-monthly bulletin series have been produced, printed and distributed to selected audiences and during meetings or presentations. The bulletin is also available online.
Brochure	General information about project	At least 4 brochures have been produced and published, both in Indonesian and English.
Leaflet	General information regarding the project	Three leaflets were produced to present technical guidelines for demonstration plot management, well construction, and well monitoring. A working calendar for one rice planting session was presented with details of work schedules and brief technical guidelines on land preparation, seeding, application of biopesticide and organic fertilization, and irrigation.
Poster	Findings, analysis, and achievement from specific project activities.	At least 23 posters have been produced to showcase Rejoso Kita, activities, and achievements.
Book	Results of specific research conducted.	At least 6 books have been produced, printed, and distributed amongst relevant organizations and individuals. The books are also available online.
Workshop	Specific discussion regarding issues to be resolved with farmers (such as FGD on matters related to sustainable rice cultivation, and well construction, and workshop at decision makers and academic levels).	At least 30 focus group discussions have been held with farmer and farmer groups on issues related to sustainable rice cultivation and well construction. At least three workshops with all stakeholders and representatives of project beneficiaries have been held.
Exhibition	General information regarding project and activities, and to date achievements.	At least four exhibitions have been held with presentations of material related to the Rejoso Kita project.
Presentation	General information regarding the project and its activities, achievements, analysis, and lessons learned.	At least 10 self-organized and invited presentations have been held at various events.
Meetings	General and specific updates regarding project activities and follow up actions.	More than 30 meetings have been held with donor agencies, government officials, non-government entities, academic and research groups, public sectors, Forum DAS Pasuruan, and farmer groups.

8.3 Monitoring of media

Media monitoring is the process by which the Rejoso Kita project keeps tracks media coverage of issues related to the project.

The Rejoso Kita project prepared press releases and invited journalists to participate at a number of events, including the following:

1. Kick off Phase 2, resulting in coverage in some 20 online and offline media outlets.
2. Demonstration plot harvesting day, resulting in coverage in a range of different media outlets.
3. Focus Group Discussion with farmers from 11 villages in two sub-districts, resulting in coverage in a number of media outlets.
4. Online Media gathering to commemorate the World Water National Day "The Value of Water" (22 journalists invited), resulting in coverage in some 21 online and offline news media outlets.
5. Media visit to Rejoso Kita project sites (upstream, midstream, and downstream), resulting in a story published in Mongabay.com and a video published by CNN Indonesia.
6. Workshop on "Integrated Watershed Management by Forum Koordinasi Pengelolaan DAS Kabupaten Pasuruan - FDP," resulting in coverage in some 19 online and offline news media outlets.

8.4 Lessons learned in the knowledge management process

The lessons learned as a result of the knowledge management process implemented during the second phase of the Rejoso Kita Project fall into three main categories (i.e., planning the knowledge management process, capturing knowledge, and sharing knowledge).

8.4.1 Planning knowledge management

Knowledge management planning is a process that needs to be implemented from the commencement of a project. This plan should guide implementation of two knowledge management processes (i.e., capturing and sharing knowledge).

In the Rejoso Kita project, knowledge management planning commenced with the selection of the Rejoso Kita project outcomes and outputs directly related to knowledge management. The next step was the identification of all stakeholders and beneficiaries involved in the project, each of which had various types of implicit and explicit knowledge. A communication plan was later developed as a guideline to capture and share the knowledge.

8.4.2 Capturing knowledge

The knowledge capturing process was conducted by identifying the institutions and individuals with knowledge relevant to the implementation of the Rejoso

Kita project. This identification process also enabled the Rejoso Kita project to initiate and maintain partnerships and collaboration with suitable organizations or individuals in producing knowledge as part of the project's implementation.

The appropriate implementation of knowledge retrieval, collection, and organization processes will enable an identification of the types of knowledge possessed by each of the stakeholder groups, enabling the project to determine the best times and occasions and the most efficient means to collect knowledge.

In the case of the Rejoso Kita project, the knowledge capturing process was implemented through a number of mechanisms, such as meetings, telephone conversations, chat groups, collaborative work, focus group discussions, demonstration plots, messages sent by text, email, or letters, guideline development, establishing a database and repositories of information, etc. the knowledge was organized according to the three main focuses of the second phase of the project (i.e., sustainable rice cultivation technology, efficient use of water by the instruction of safe and proper artesian well drilling, and institutional strengthening of the integrated watershed management coordination body).

The lessons learned from this process was that the use of a wide range of mechanisms is essential to ensure that all relevant knowledge is collected and utilized in the most efficient ways.

8.4.3 Sharing knowledge

The second phase of the knowledge management process involves the sharing of knowledge (i.e., the process of producing, communicating, exchanging, and/or socializing the knowledge to targeted audiences, particularly project stakeholders and beneficiaries).

A communication plan was developed to act as a guideline to enable the project to share the knowledge it had identified and collated. Clear communication objectives are essential to enable knowledge products to communicate to targeted audiences effectively as possible and through a wide range of channels (see Table 38).

Table 38. Lessons Learned from Sharing Knowledge of Rejoso Kita

Components	What Works	Need Improvement
Communication Plan	It is important to develop a communication plan at the commencement of the project to establish guidelines for conducting communication activities (knowledge to capture and share).	More detailed explanation is needed for each communication component (objectives, messages, audiences, channels, tools) but this should not prevent modification and adjustment in line with the project's development.

Components	What Works	Need Improvement
Objectives	It is important for project management to consider the objectives of the communication process throughout the planning and implementing of project activities.	More detailed objectives need to be developed for specific communication activities to better measure achievements and impacts.
Messages	General messages for each project activity give the project management a clear direction in planning and implementing project activities.	Messages will need to be refined and compartmentalized to provide more specific messages to support the general messages.
Audiences	Detailed elaboration of the audiences targeted for knowledge sharing was conducted well, enabling the project to monitor the flow of information to different stakeholder groups.	
Channels	It is essential to target both online and offline channels to ensure that all stakeholders are reached.	
Tools	The list of communication tools is comprehensive.	
Monitoring and Evaluation		A monitoring and evaluation plan needs to be developed, together with tools for implementation. With this, expectations regarding communication activities and achievement can be managed and impacts can be measured.

CHAPTER 9
LESSONS LEARNED AND RECOMMENDATIONS FOR FUTURE WORKS

Beria Leimona, Ni'matul Khasanah, Karyanto Wibowo

9.1 Sustainable paddy cultivation

Sustainable paddy cultivation (SPC) involves the production of healthy rice through the application of balanced fertilizer, which is used as an intermediary step leading to the use of fully-organic fertilizer. In addition, a system of intermittent irrigation is used to increase the efficiency of water usage and to decrease the emission of greenhouse gases. The paddy is planted in broader spaces (i.e. *jajar legowo*) to enable sunlight to penetrate, thereby decreasing the incidence of diseases resulting from high levels of humidity. Finally, pests and diseases are controlled through the use of biopesticide. Despite the environmental and production benefits, SPC results in higher costs for farmers, at least at the early stages of its implementation. Also, at these stages farmers may have limited knowledge regarding how the system should be implemented. Thus, they require various forms of support and facilitation.

The Rejoso Kita project implemented SPC on an area of land covering 65.1 ha, involving 184 farmers from 10 farmer groups in seven villages in the downstream area of the Rejoso Watershed. Of these 65.1 ha, 35.9 ha were planted according to a harmonized planting calendar, with this area of land involving 110 farmers from five farmer groups in two villages. The implementation of SPC resulted in improvements to paddy quantity and quality, although there were only marginal differences in the prices received by farmers. SPC has the potential to increase the production of grain by 32 percent, to increase net profits by 123 percent, to result in a reduction to the emission of greenhouse gases by 36 percent, and to increase the efficiency of water usage by 15 percent relative to conventional practices.

9.1.1 Design phase

1. **Understanding local knowledge and practices, issues affecting farmers and expected outcomes.**

   - The Rejoso Kita team conducted a series of focus group discussions and group meetings followed by frequent informal meetings with the local communities. Thus, the facilitators gained a deep understanding of issues affecting farmers. Rice farmers in the downstream area of the Rejoso Watershed suffer persistent pest

infestations, particularly involving rats and plant diseases. They are also impacted by the high and volatile prices of chemical pesticides, constraints on access to fertilizer due to distribution and stocking issues; limited availability of labor especially, for land preparation and planting; lack of the capital required for planting if they experience crop failures in the previous season; and a lack of government extension services.

- The Rejoso Kita program implemented interventions based on solutions proposed by the farmers combined with the solutions based on the scientific/technical results. For example, when the program proposed the implementation of the 'jajar legowo' 2:1 planting patterns, the farmers generally welcomed the initiative, as it made their work during weeding, fertilizing, and spraying biopesticides easier and more efficient. However, not all farmers were familiar with the techniques involved. They were also concerned that planting using jajar legowo patterns would be more expensive than planting using conventional patterns. Then, the facilitators consulted national agriculture research experts and recommended a 4:1 planting pattern, which was more affordable and thus preferred by the farmers, without compromising its ability to reduce disease and humidity.

2. **Providing information and conducting training with practices that support the implementation of SPC** (particularly involving the production of organic biopesticides and liquid fertilizers using readily available ingredients and the use of paddy soil test kit (PSTK) and leaf color charts (LCC) to ensure balanced/efficient use of fertilizer).

- Farmers welcomed the initiative to produce organic biopesticides and liquid fertilizers, given that the raw materials used could be obtained from their surrounding environment (e.g., papaya leaf, garlic, galangal, etc.). They also recognized that organic pesticides and liquid fertilizers would be cheaper than their chemical equivalents and less damaging to the environment. They were reassured that they would still be permitted to use chemical fertilizers and pesticides in the case of severe pest and disease attacks. It was recognized that the shift from chemical to organic inputs would require a process, especially for managing weeds, which could result in high costs for farmers if the treatment was unsuccessful or took too long. The facilitators introduced the use of PSTK and LCC to raise awareness of the benefits of SPC to show that

PSTK and LCC increase the benefits of SPC. The combined use of chemical and organic fertilizers could play a role in improving soil conditions in the long-term, while the excessive use of chemical fertilizers could cause plant toxicity and increase soil acidity.

- The training process involved experienced trainers, government officers, and knowledgeable farmers and used peer-to-peer sharing experience techniques. The facilitators engaged a champion from a neighboring village to promote the use of these environmentally friendly agricultural inputs. Experienced facilitators are crucial to ensuring optimum training results. Furthermore, special attention was required to meet the needs of elderly farmers. For example, while PSTK and LCC are simple and easy to use, it was recognized that elder farmers would need extra training to apply new innovations.

3. **Establishing on-farm demonstration plots to showcase the improvements to both the quantity and quality of harvests, water-use debit and rate of greenhouse gas emissions under various scenarios.**

    - The Rejoso Kita project implemented demonstration plots in two phases to ensure that the plots reflected current conditions, and to ensure that the level of water use with the implementation of SPC was measured accurately. Farmers clearly appreciated the value of the demonstration plots as a learning tool.

9.1.2 Implementation, monitoring and evaluation phase

1. **Conducting frequent formal and informal group meetings to build social capital and to foster collaborative work among farmers.**

    - In Pasuruan, while farmer groups existed prior to the implementation of the project, they have not been leveraged to conduct collaborative projects. During the implementation of the project, the facilitators arranged a series of formal and informal meetings to consult with farmers, to evaluate the implementation of SPC, to raise awareness of the value of collective SPC planting and rotation with non-rice crops throughout a season, to improve farmers knowledge regarding the maintenance of irrigation canals, the control pests and diseases, and other agricultural activities.

2. **Supporting farmer groups to develop a dedicated healthy rice supply chain and collaborating with external parties to enable them to sell premium rice at higher prices.**

- While the rice produced using SPC can be categorized as healthy rice, it has not yet been certified as such. The premium pricing strategy is an incentive system to ensure farmers' continued interest in the implementation of SPC. However, tapping this niche market is challenging, especially during the initial stages, as the quantity of rice produced is still limited. In the case of rice, a dedicated supply chain must be established to guarantee that the harvest is not mixed with other rice, thereby degrading its value.

3. **Monitoring socioeconomic and ecological indicators of SPC to ensure that the climate-smart interventions are measurable quantitatively and qualitatively; to raise awareness of other farmers in adopting the practices; and to provide scientific-based evidence to policymakers.**

    - The implementation of SPC has been demonstrated to increase paddy productivity relative to conventional methods, which is one of the principal indicators to determine its suitability for scaling up. While SPC has been clearly demonstrated to have the potential to improve productivity, it is also important to give particular consideration to issues such as uncertain weather conditions (e.g. la Nina events that may result in floods) and inefficient irrigation channels that may impact its implementation.

9.1.3 Upscaling and exit strategy

1. **Transitioning from non-contiguous plots to harmonized planting on contiguous blocks.**

    - The Rejoso Kita project has successfully facilitated farmers' participation in harmonized planting on contiguous blocks of land. This can only be implemented if farmer groups are empowered with sufficient knowledge regarding the application of SPC and the self-replication of these practices. Harmonized planting on contiguous blocks of land reduces the occurrence of pest and disease infestations that may reduce the quality and quantity of the harvest and facilitates the effective regulation of irrigation systems. In addition, it results in agglomeration effect by ensuring production of a sufficient volume of rice to enable it to be recognized as a premium product, thereby facilitating marketing.
    - As part of the projects exist strategy, villages in two subdistricts (Gondang Wetan and Winongan) where block planting was conducted committed to enacting a Village Regulation to promote harmonized planting on

contiguous blocks of land. This regulation will become a basis to ensure the sustainability of SPC and to channel government support, including through the allocation of village funds to maintain irrigation channels, to provide straw crunching machines, and to encourage water distribution controllers to play a more active role.

2. **Supporting farmer groups to establish partnerships with supply chain actors to market both healthy organic rice and other commodities produced through the practice of crop rotation. To ensure market access, support from financial service providers is required to improve farmers' access to capital, thereby enabling them to implement holistic climate-smart agriculture practices.**

    - The Rejoso Kita project facilitated the farmer groups' participation in cooperatives in Pasuruan. As a result of this facilitation, the Tekad Usaha Mandiri (Tekun) savings and loan cooperative, a cooperative committed to supporting smallholder farmers and environmental sustainability, has established a new regional branch in East Java with the support of the Rabo Foundation.
    - Participation in cooperatives was deemed to be an optimal means of accommodating the financing needs of smallholders, with other financing scheme alternatives being marred by constraints related to the perceived unbankability of smallholder farmers, with many financial institutions reluctant to serve this group.
    - To ensure the penetration of premium markets, the project has attempted to establish a marketing network through a partnership with Danone.

3. **Mainstreaming SPC into the government development planning and budgeting, including through an intensification of the role of government agricultural extension services and staff.**

    - There was a recognized need for government agricultural extension services to establish better channels of communication with farmers and farmer groups. More intensive facilitation by extension staff is required to enable farmers to consistently apply all the components of SPC.
    - At the district level, Agricultural Services could play a valuable role by activating the Unit Pelayanan Jasa Alsintan (UPJA)/ agricultural machine service unit to overcome issues related to the limited availability of labor and to facilitate UPJA cross-learning, given that there are already a number of successful UPJA operating in the district.

4 **Encouraging younger people's involvement in SPC by ensuring the uptake and adoption of modern technology through interventions involving farmer group cooperatives and by establishing agribusiness through digital markets and agri-ecotourism.**

9.2 Community artesian wells

Since around 1980, there has been a large-scale construction of community wells in the district, with the construction of around 600 wells. Appropriately constructed artesian wells are characterized by the following: (a) setting pipes to the bottom of the well to prevent blockages resulting from the collapse of the borehole wall; (b) strengthening the pipes through the use of cement casting; and (c) the installation of a water valve to control water flow (e.g., closed when not in use). With the implementation of the project, four appropriately designed pilot wells were built in three villages in the downstream area of the Rejoso Watershed, with their management and maintenance involving four farmer groups.

9.2.1 Design phase

1 **Frequent and intensive meetings were conducted with local community members to increase awareness of advantages of constructing new artesian wells compared to maintaining old ones, with interventions to improve their knowledge of the upstream and downstream areas of the watershed as a holistic hydrological system.**

- The local communities consider water to be a freely available resource, to be exploited without cost. To address this, the facilitators conducted interventions to raise awareness by introducing concepts related to hydrological cycles, water sources, and the role of a healthy watershed in ensuring the ongoing availability of water of sufficient quality and insufficient quantities. These interventions were conducted to transform the behavior of the local community by improving their understanding of the value of maintaining and restoring the environment and utilizing water resources efficiently. In these interventions, the facilitators emphasized the role and functions appropriately designed wells and measures to improve water use efficiency.

2 **Clarifying project outputs and impacts on water efficiency.**

- One of the key performance indicators of the Rejoso Kita project related to the number of old wells closed and the number of new, appropriately designed wells constructed. The output-based KPI is a good proxy for 'water efficiency target in liter/second.' Improved water efficiency can be regarded as a project impact rather than

a project output, as many external factors influence the achievement of improved water efficiency, which is highly dependent on the efficiency scale. To improve water efficiency, a project would need to focus on a landscape-wide intervention, starting with comprehensive research to understand and calculate the water supply demand in the watershed to ensure that the regulation of well construction is appropriately implemented. The construction and maintenance of appropriately designed artesian wells is only one factor, with other factors including, for example, upstream restoration, water-efficient farming practices, and consumption regulation.

3. **Ensuring close coordination between parties involved in similar and related initiatives.**

   - In parallel to the implementation of the project, similar well construction activities have been implemented by a range of local partners, including those facilitated by private sector CSR funds. It was important to facilitate a high level of coordination between the partners to ensure that similar design principles and negotiation processes were implemented, especially with regard to water debit control and monitoring. A lack of uniform design, control and monitoring procedures may result in a high level of confusion amongst farmer groups, members of the community, government agencies, and all other stakeholders.

9.2.2 Implementation, monitoring, and evaluation phase

1. **Establishing good relationships with local communities to negotiate processes related to new well construction that comply with the expected standards.**

   - Without intervention, local communities tended to request higher than necessary water discharge from the new wells and sometimes expressed unwillingness to manage wells that did not meet these expectations. To manage these expectations, interventions were required to raise and maintain awareness of the need to consume water efficiently. The effective maintenance and monitoring of artesian wells is heavily dependent on the willing participation of farmer group members. Thus, for the achievement of water efficiency goals, it is vitally necessary to ensure that they are entirely on-board with the target levels by convincing them that reduced levels will not diminish the quality and quantity of their output.

2. **While appropriate construction of artesian wells is affected by their location and context, construction of such wells may often be more expensive than that of conventional, less efficient wells.**

   - During the construction process, the difficulty of reaching the deep aquifer is heavily dependent on the depth and surface hardness of the soil, with the process taking considerably longer when the soil stone layer is deep and hard. Under such conditions, broken drill bits are relatively frequent occurrence. Thus, the longer the process takes, the higher the associated costs will be.
   - The project found that the cost of an appropriately designed artesian well stands at around USD 3000 - 5,000, which is 300 percent higher than that of a conventional well (about USD 750 - 1,200). The quality of construction of conventional wells is heavily dependent on the size of the budget, resulting in wide variations in price. The expensive equipment used for the construction process is vulnerable to crime and sabotage.

3. **Involving the farmer groups and local community in controlling and monitoring the water debit use.**

   - One of the key factors in ensuring the achievement of the project targets relates to the level of willingness of farmer groups and local community members to comply with the terms of the contractual agreement by limiting the use of water by the effective and appropriate operation of valves (i.e., opening and closing as required). In many cases, the local community is enthusiastic about the construction of a new well in the initial stages, but does not pay sufficient attention to valve operation. This could actually result in reduced water efficiency compared to conventional wells, given that the new wells tend to be characterized by larger water debits. Ideally, village heads will receive regular updates from the well monitoring group to ensure compliance with the contractual agreement. From the results of the monitoring of the constructed wells, it was found that the community was able to achieve higher levels of water efficiency, at 14.3 liter per second over the period from January 2021 to June 2022.

4. **Engaging the local agriculture water user association (HIPPA) and irrigation managers to ensure the irrigation channels operate efficiently (e.g. no debris or broke construction that may delay the water flow or leakage) so that each farmer's plot receives sufficient water to meet their needs.**

9.2.3 Upscaling and exit strategy

1. To facilitate the design of projects intended to improve water efficiency, there is a need to conduct a comprehensive research into a range of issues related to groundwater and its usage, including levels of supply and demand and the needs and issues faced by water users, particularly smallholder farmers and other members of the local community, whose needs are prioritized by government regulation. In particular, there is a need to determine the specific needs and issues affecting farmers in different areas, such as particularly dry areas

    - The Rejoso Kita conducted research on these issues in collaboration with the University of Gajahmada. Based on the precipitation index and distribution of artesian wells, the study found that although all villages in Pasuruan have potential access to groundwater, most experienced water shortages. Thus, reductions in the number of artesian wells, as required by the project, could meet with resistance from local communities. The research found that while access to water is limited in some areas, others are characterized inefficient groundwater management.
    - Only 14 percent of water flowing from current artesian wells is utilized, indicating a very high level of inefficiency in groundwater use. Villages that experienced persistent water shortages included Tebas, Bajangan, Gondangrejo, Rangggeh, Sekarputih, Gondangwetan, Pekakungan, Lajuk, Kalirejo, Grogol, and Pateguhan (Gondang Wetan) and Umbulan, Kedungrejo, Sidepan, Sumberejo, Jeladri, Karangtengah, Sruwi, Minggir, and Winongan Lor (Winongan). The study recommended that water from the existing artesian well with discharges of 5 – 20 l/s be distributed to the villagers experiencing water shortages.
    - The demand for water for domestic usages (60%) was found to be much higher than the demand for agricultural uses (1%). Thus, increasing the efficient sourcing and distribution of water for domestic uses would have a greater impact in terms of increasing overall water usage efficiency. It was also found that small-, medium- and large-scale industries tended to disregard water efficiency and waste management issues, resulting in a voidable pollution. To address these issues, local government agencies must strengthen law-enforcement and compliance with standards.

2. Selecting various farming practices and commodity options to target improved water efficiency in the agricultural sector.

- The Rejoso Kita focused exclusively on the use of water for the cultivation of rice, rather than for the agricultural sector as a whole. Irrigated rice cultivation consumes a relatively high level of water compared to other commodities. Thus, it is essential to link the recommendations described in the previous section on climate-smart farming practices, including those related to the enabling conditions of access to market and finance for non-paddy commodities as an integral component of water efficiency design.

3. Ongoing advocacy to strengthen and improve local government regulations, policies, and programs to support good groundwater management is required to ensure that watershed conservation is conducted systematically and comprehensively.

   - While national regulations provide an effective overall framework, there is a need to strengthen and improve sub-national technical regulations to translate the broad principles contained in the national regulations into the effective implementation of 'one basin, one management' at the local level. At present, these subnational technical regulations are poorly developed or non-existent. The Rejoso Kita project found that technical regulation can be initiated at the micro scale (i.e. village level) through the enactment of village regulations related to groundwater management. Following their implementation at the village level, the lessons learnt can be upscaled to higher levels, including the subdistrict, district, and provincial levels.
   - An important aspect of village regulations relates to fees and charges that can be used to finance systems to ensure fair water distribution and the construction, maintenance, and monitoring of appropriately properly designed artesian wells, and to contribute to the restoration of upstream areas of the watershed.

9.3 Multistakeholder watershed forum

1. The project demonstrated that there is a vital need to understand a multistakeholder forum's governance, role and responsibility at different scales.

   - The establishment of Watershed Management Coordination Forums is mandated by Article 57 of Government Regulation Number 37 of 2012 concerning Watershed Management. These multi-stakeholder forums can be established at the national, provincial and district levels, as stated by Ministerial

Regulation Number 61 of 2013. The forums are intended to ensure the institutional development of integrated watershed management.

- Phase 1 of the Rejoso Kita project focused on facilitating the development of the provincial-level watershed forum, due to the project's focus on sourcing water fund from the Umbulan Spring national project, which falls under the mandate of the provincial agency.
- Phase 2 of the Rejoso Kita project focused on revitalizing the district-level watershed forum, due to the project focus on the cultivation of patty by smallholders in the downstream areas of the watershed, with specific emphasis on improving the efficiency of water usage within the agriculture sector. Thus, it was appropriate to conduct interventions at the district level, with agencies at this level holding the mandate for matters related to smallholder agriculture.

2. The revitalization of the watershed forum was intended to ensure its effectiveness in the context of current integrated watershed management principles and practices, which are output- and performance-based oriented.

    - The process of revitalizing the watershed forum was initiated through a process of stakeholder mapping to identify individuals and representatives of institutions to establish a Technical Team to address issues related to watershed management in Pasuruan.
    - As a result of intensive and lengthy facilitation, the Technical Team produced a number of significant documents, including (i) Pasuruan District Head Decree on FDP Organizational Structure; (ii) Tasks and Authorities (job description) of each member; (iii) Technical Guideline for Governance of Land and Water Conservation Funds; (iv) template of proposals for payment for environmental services programs; (v) integrated watershed and water resource management roadmap; and (vi) Pasuruan District Head Decree on Environmental Economic Instruments.

9.4 Knowledge management

1. The project established a knowledge management plan as a guideline for to implement communication activities (knowledge to capture and share).

    - The project found that the plans must be sufficiently detailed to ensure the effective communication of the project's objectives through messages that can be succinctly

delivered and that targeted the appropriate audiences through the appropriate communication channels and tools. At the same time, these plans needed to be sufficiently flexible to enable modification and adjustment as the project developed.

2. The knowledge management process needs to effectively target audiences through a wide range of channels, using a range of methods and techniques to capture knowledge.

   - The Rejoso Kita categorized the knowledge gained from targeted beneficiaries and audiences into three areas relevant to the project's goals: (i) the implementation of sustainable rice cultivation technology; (ii) efficient water uses through the construction of appropriately designed artesian wells; and (iii) institutional strengthening of the multistakeholder watershed forum.
   - Targeting through online and offline channels was essential to ensure that all stakeholders were reached, particularly in the context of the pandemic-related restrictions. In this context, knowledge-capturing process was implemented through a range of mechanisms, including face-to-face and virtual meetings, telephone conversations, chat groups, collaborative work, focus group discussions, the establishment of demonstration plots, and messages sent by text, email, or letters.

3. The knowledge management process needs to be effectively monitored and evaluated, together with the tools for used for its implementation. Through this process, expectations regarding communication activities and achievement can be managed and impacts can be measured.

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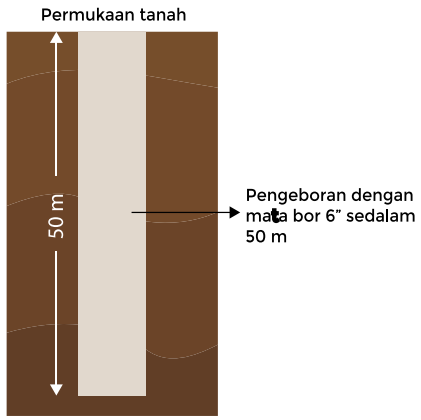
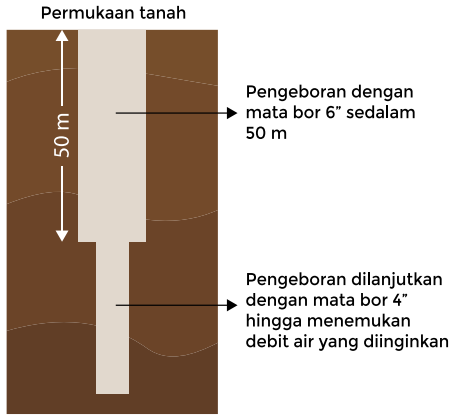
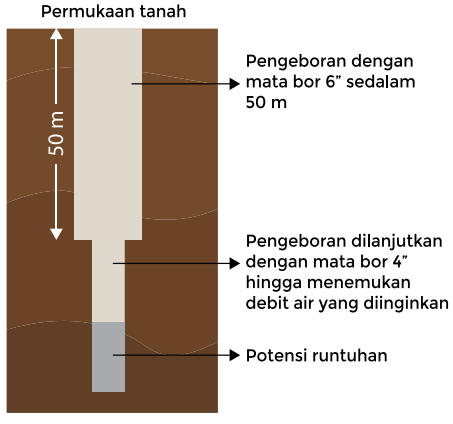
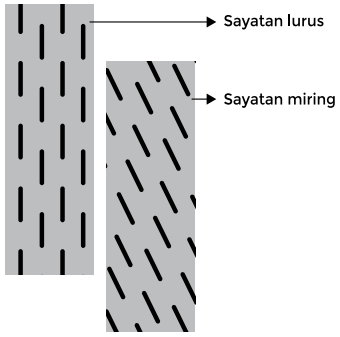
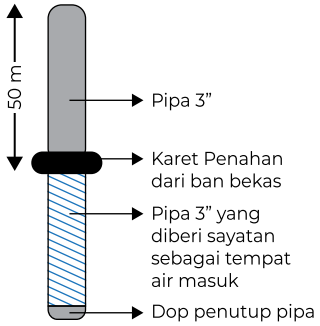
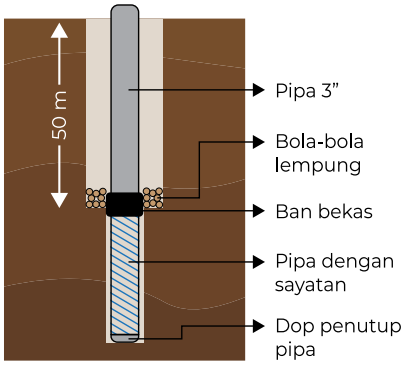
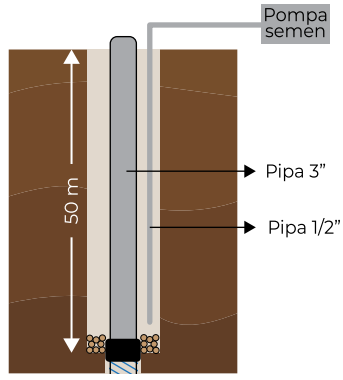
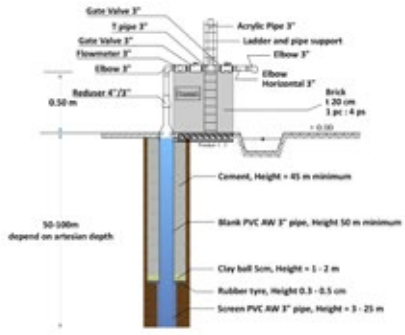
APPENDIX

DRILLING AND CONSTRUCTION PROCEDURES *)

1	Drilling starts using 6-inch drill bit to a depth of 50 meters.	
2	Drilling is continued by using a 4-inch drill bit to a specific depth according to the desired water discharge. *Note:* • Keep measuring the water discharge as the depth increases to ensure that the flowrate obtained is in accordance with the needs, neither less nor excessive. • The drilled well will be fitted with a 3-inch construction pipe. The cavity created between the 3-inch pipe and the well wall (previously drilled using a 6-inch drill bit to a depth of 50 meters deep) will be filled with cement casting to make the wall of the well strong and not easy to collapse.	
3	Clean the wellbore using a slurry pump (if available). *Note:* • During the drilling process, the potential for collapse of the well wall occurs at a depth of more than 50 meters. • Cleaning is carried out so that the 3-inch pipe can be inserted to the depth of the aquifer (water source). • The target depth of the 3-inch construction pipe is more than 50 meters.	

4	Construction pipe preparation *Note:* • 3-inch PVC AW pipes. Each pipe is four meters length. Total length is 52 meters (or 13 pipes). • 3-inch PVC AW pipes. Each pipe is four meters length. Each pipe is cut using a grinder in a regular pattern (slanted or straight). The number and length of the slashed pipe (screen) adjusts the depth of the aquifer (water source).	
5	Insert the pipes to the wellbore. *Note:* • First insert the slashed pipes (screen) followed by the ordinary pipes (without slash). Each pipe is joined or connected to each other using PVC glue. Lower one by one while holding them down with ropes or clamps to avoid falling. • Wrap the pipe with some rubber strap (6-inch thick) as retainer at a depth of 50 meters (position right above the uppermost slashed pipe). • Rubber strap functions: (1) blocking water from escaping from side gaps, and (2) keeping cement from leaking downwards during casting.	
6	Inserting clay balls *Note:* • The diameter of each clay ball is one or two cm made from about 40 liters of clay to be inserted into the cavity between the 3-inch construction pipe and the wellbore.	

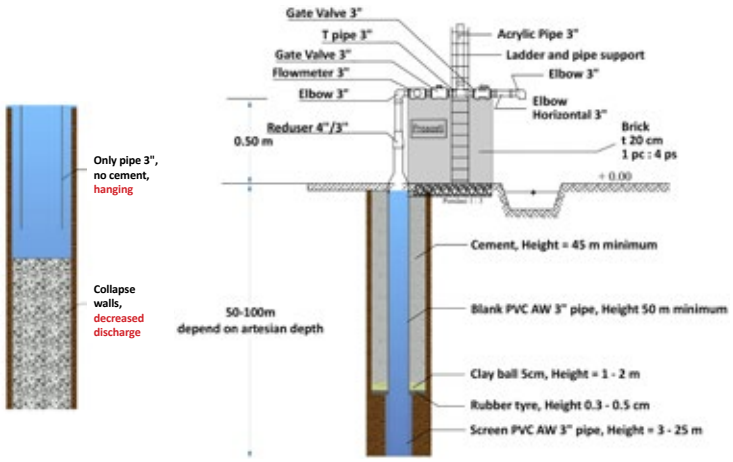
7	Cement casting *Note:* • Insert a ½-inch pipe to a depth of 45 meters (close to the retaining rubber) one by one. Connect or join each pipe to each other using the existing threads or PVC glue. These connected pipes will function as a cement conveying pipe. • Pump cement from the mixer through the conveying pipe. • Remove one conveying pipe (@4m) when 8-10 sacks of cement have already been pumped (so that it is not heavy) • The amount of cement required is 40-60 sacks, @40kg each • Mixture: for 1 sack of cement, add 18 or 20 liters of water.	
8	The installation of the upper well construction components should follow the cross-sectional drawing as shown on the front page of this information sheet.	

**) for wells more than 50 meters depth*

TOOLS AND MATERIALS

TOOLS		AMOUNT	UNIT
1	Personal protective equipment	As many workers	-
2	Cement mixer	1	Unit
3	Cement semen	1	Unit
4	Artesian well drilling equipment	1	set
MATERIALS			
1	½ inch PVC pipe for conveying cement	50	m
2	Cement @40 kg	40-50	zak
3	3-inch PVC AW pipe	According to the depth of well	m
4	Clay balls	40	liter
5	Used inner tube (rubber)	As necessary	-
6	PVC glue	As necessary	-
7	2-inch PVC clamp	As necessary	-
UPPER WELL CONSTRUCTION			
1	3-inch transparent acrylic pipe	1	m
2	3-inch transparent acrylic pipe connector	1	Ls
3	Max 1.5/2.5 bar water pressure gauge	1	Ls
4	Fitting (Tee 1) 3" (PVC AW)	1	Ls
5	Fitting (Y) 3" (PVC AW)	1	Ls
6	3-inch ball valve	1	Ls
7	3-inch gate valve	1	Ls
8	3-inch water flow meter	1	Ls
10	Y joint mount	1	Ls

ARTESIAN WELL IN THE DOWNSTREAM OF REJOSO WATERSHED PASURUAN DICTRICT – EAST JAVA



In 2019, the number of groundwater artesian wells in the downstream area of the Rejoso watershed reached approximately 600 points. Almost all were built without control or regulation valves.

Even when not used, water flows continuously for 24 hours. Underground leakages cause water to escape and loss. Left unchecked, how long will the precious groundwater last?

Rejoso Kita encourages the people in the watershed to follow correct well drilling and construction procedures to preserve the groundwater.

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