Chapter 7
Incentive Mechanisms, Monitoring and Evaluation, and Communication of the CORIGAP Project

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Abstract In this chapter, we propose a framework of market-based incentive mechanisms for the adoption and scaling of sustainable production standards throughout rice value chains and review evidence of two mechanisms that have been piloted in Vietnam: "internalizing" and "embodying." The evidence suggests that sustainable production standards can be successfully "internalized" in rice value chains through policies (public governance) that provide an enabling environment for vertical coordination and private governance of standards (e.g., through contract farming). However, the major challenge policymakers and value chain actors face for this mechanism to succeed is to reconcile differences in contract preferences between contracting parties and solve trust and coordination issues (e.g., contract breach and side-selling). Market evidence suggests that sustainable production standards can be successfully "embodied" in rice products through certification and labeling. Vietnamese consumers were found to put significant price premiums on sustainable production certification and even more so if supplemental information is provided on certification and traceability. Both examples highlight the role policymakers can play in the adoption and scaling of sustainable production standards throughout rice value chains by creating an enabling environment for vertical coordination and private sector investment in certification and information campaigns. We conclude by discussing how policymakers can overcome the challenges for these mechanisms to succeed and identifying

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areas for future research. Furthermore, we provide a detailed description of the monitoring and evaluation process of CORIGAP activities. We explain the development from paper-based to computer-assisted survey tools, the evaluation of changes that farmers perceive and provide a case study on impact evaluation using econometric analysis. It becomes clear that a multidimensional project like CORIGAP needs a variety of means to assess the changes on different levels. We found that farmers in all CORIGAP countries perceive positive changes. Their yields and profits have increased, and the project has exceeded its target reach in all countries. This was also due to other funding schemes that supported CORIGAP technologies and practices, such as the rollout of 1M5R in Vietnam and the 3CT in China. The project used a variety of dissemination strategies to communicate the outputs and outcomes to a plethora of different stakeholders. Among the most successful were social media campaigns, including informative videos about CORIGAP technologies and practices. The chapter closes with some anecdotal evidence of how, especially postharvest technologies, influenced policies in the CORIGAP countries. We provide lessons learned from the project to be taken care of in future projects that aim to introduce sustainable agricultural practices and technologies to improve natural resource management.

Keywords Rice value chain · Knowledge management · Impact assessment

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7.1 Incentive Mechanisms for the Adoption and Scaling of Sustainable Production Standards Along Rice Value Chains: Evidence from Vietnam

Vietnam's agriculture sector has been a key driver to its economic growth and concomitant to poverty reduction. The sector contributes to around 14% of Vietnam's GDP, employs 38% of the national workforce, and has played a major role in reducing poverty to less than six percent (World Bank 2022a). Vietnam has positioned itself as a global producer and net exporter of rice for many years. This status has created opportunities for Vietnamese rice as a main export product and driver of its agricultural growth over the years. Rice production in 2020 was estimated at 28 million metric tons (FAOSTAT 2022), of which 5.6 million tons were exported to Africa and rice-importing countries in Asia, earning the country around US$3 billion in export revenue (UN Comtrade 2022). Vietnam has long maintained the status as a producer of low-quality rice (Demont and Rutsaert 2017), and rice exports face strong competition from India, Thailand, and Pakistan.

Despite the impressive growth in the sector, the country faces a trade-off between generating foreign exchange from rice exports and ensuring environmental sustainability. Vietnam's agriculture sector is the second main contributor to the country's greenhouse gas emissions (GHGEs) and about half (48%) of the GHGEs and more than 75% of methane emissions come from rice (World Bank 2022a). Growth in output and yield has also plateaued in the last decade, attributed to the adverse impacts of climate change and environmental degradation. Rice farmers receive lower net incomes compared to other farming households cultivating other crops (World Bank 2022a). This plateau in rice yield is expected to be further exacerbated by climate change. By 2030, climate change impacts may result in reductions in rice yields of over 6% and reach up to more than 13% by 2050 (World Bank 2022a).

This calls for urgent action for rice value chain actors to transition to more sustainable production practices, which would eventually provide an opportunity for Vietnam to raise its status as a producer of high-quality and sustainable rice and meet the rising global demands for sustainably produced products.

Here, we present a framework of entry points for introducing and scaling up sustainability along rice value chains. The succeeding sections dig deeper into two market-based incentive mechanisms that were piloted in Vietnam to understand how sustainable production practices could be robustly scaled up. We conclude by identifying key policy messages.

7.1.1 *Spearheading Sustainable Rice Value Chain Development*

In recent years, sustainability has been at the forefront of the development agenda through the Sustainable Development Goals (UN 2015). Achieving sustainability in food value chains requires a holistic approach by ensuring sustainability not only from an economic perspective but also from social and environmental points of view (FAO 2014). A sustainable food value chain is defined by FAO (2014) as "the full range of farms and firms and their successive coordinated value-adding activities that produce particular raw agricultural materials and transform them into particular food products that are sold to final consumers and disposed of after use, in a manner that is profitable throughout, has broad-based benefits for society and does not permanently deplete natural resources." The implication is that strong linkages and well-coordinated activities among actors from production to consumption need to be in place to upgrade food value chains.

Improving value chains, also referred to as value chain upgrading, thus requires a holistic approach engaging with the different actors depending on the identified bottlenecks along the value chain and potential for improvements. Marketlinks.org defines five different types of upgrading. CORIGAP-specific examples where the project contributed to the introduction of more sustainable practices working toward sustainable production standards will be given in the definitions below.

Process upgrading increases the efficiency of production either through improved technology or through better organization of production. An example from CORIGAP is the development and introduction of hermetic storage systems to replace traditional seed and grain storage systems and the losses incurred in those.

Product upgrading improves product quality and value for customers. The SRP sustainability standard, which is one tool co-developed by CORIGAP, is one tool to facilitate product upgrading by introducing certified SRP rice.

Functional upgrading is the entry of a player into a new, higher value-added function or level in the value chain. It can also include a restructuring of roles in the value chain, e.g., in contract farming schemes. CORIGAP did not engage in facilitating or supporting functional upgrading but extensively studied examples in Vietnam and captured the lessons learned as described below.

Channel upgrading occurs when an actor enters one or more new end markets with the same basic product. Examples are enabling farmers to sell high-quality rice in the retail market in Yangon instead of low-quality rice to local millers in Myanmar (see also Sect. 2.1) or working with farmers and millers in Vietnam to produce Sustainable Rice Platform (SRP) certified rice (see below).

Intersectoral upgrading is the entry of an actor into a completely new value chain or industry, assisted by CORIGAP, e.g., through the support of sustainable rice straw management, which is required to develop and pilot value chains for rice straw products.

Consumers in international food markets are increasingly paying attention to how food is produced. Intent to purchase products that meet certain standards, such as inclusiveness, reduced environmental footprint, and safety, is undoubtedly growing. Sustainably produced products and organic foods are generally perceived by consumers to have higher nutritional value and be safe to consume. Consumers demand safer and higher-quality products. Value chain actors can capture this economic opportunity from these growing market trends by upgrading value chains by improving product quality, processing, and diversifying varieties, products and by-products, and market channels. Smallholders can tap into higher-quality markets by adopting sustainable production standards.

Sustainability in the rice sector is promoted through the SRP Standard for Sustainable Rice Cultivation, the world's first voluntary standard for producing sustainable rice. The Sustainable Rice Platform (see www.sustainablerice.org) is a global multi-stakeholder alliance convened in 2011 by the UN Environment Programme (UNEP), the International Rice Research Institute (IRRI), and German Agency for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit, GIZ). The standard sets more efficient standards for rice cultivation and includes requirements that assess the sustainability of a rice cultivation system via 41 requirements which fall under eight broad themes. In 2010, IRRC scientists were involved in initiating the SRP by conducting four studies on the rice value chain in Thailand, which included a Participatory Impact Pathway Analysis (PIPA) workshop on sustainable rice production in cooperation with UNEP and the Thai Rice Department. CORIGAP scientists and national partners then worked on the definition and verification of the sustainability indicators for rice and on the development of a field calculator for sustainable rice.

Mainstreaming rice sustainability standards implies understanding the mechanisms that can be used to encourage the uptake of sustainable production standards along rice value chains. Ideally, an optimal mix of multiple strategies should be implemented to upgrade value chains. Figure 7.1 proposes a portfolio of eleven entry points along rice value chains which could be targeted for upgrading strategies that aim at enhancing their sustainability and making them more responsive to emerging market opportunities in this space: breeding, agronomy, postharvest, by-products, contract farming, markets, finance, policy, input provision (seeds), service provision, and credit markets.

Breeding. Breeding is the very first entry point that can be tapped into for building sustainable rice value chains. For example, rice breeding programs can strategically incorporate market intelligence across the three dimensions of sustainability (economic, social, and environmental) into product design. In value chain upgrading jargon, this is termed "product upgrading" (Demont et al. 2020). Market-driven, gender-intentional, and climate-resilient target product profiles (TPPs) can guide rice breeding programs in varietal development (Polar and Demont 2022) and hence help build ("pushing") sustainability in rice value chains at their very basis.

Agronomy. There are significant yield gains and environmental benefits that can be achieved through improved agronomy. Even with the best available sustainability-enhancing rice varieties developed through breeding, poor agronomic practices at farm level remain important bottlenecks for the success of value chain upgrading, as they may result in poor quality of paddy and, consequently, poor quality of milled

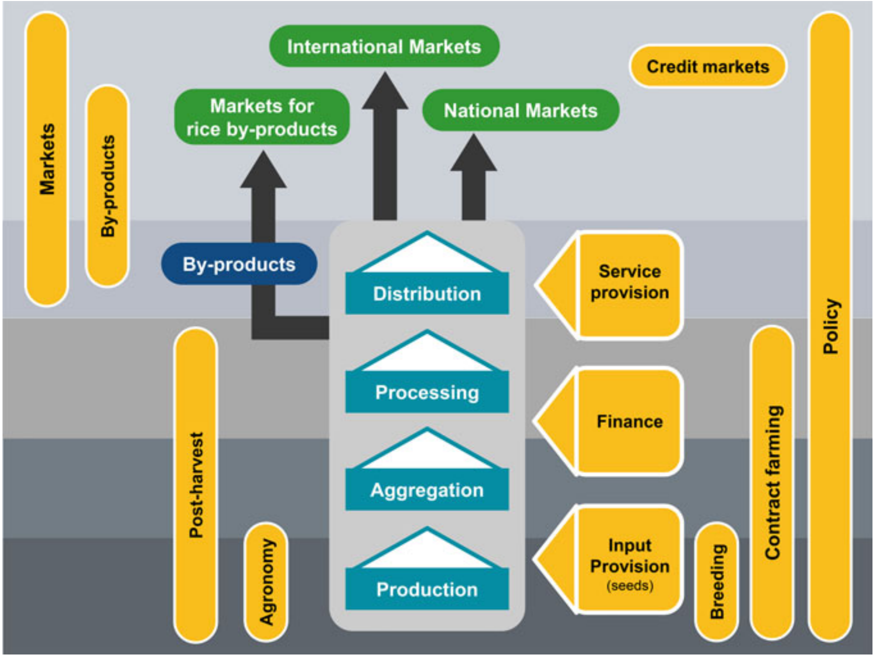

Fig. 7.1 Entry points for sustainable production standards in rice value chains (adapted from FAO 2014)

rice, which can affect the marketability of rice produced. Targeting agronomy as an entry point for sustainability could be through "process upgrading" by developing and encouraging the adoption of sustainable and climate-resilient production practices such as proper land and water management and the use of seed and climate-responsive technologies. Voluntary standards such as the Vietnamese Good Agricultural Practices (VietGAP), Global Good Agricultural Practices (GlobalG.A.P.), organic, and Hazard Analysis and Critical Control Points (HACCP) are being offered for uptake in the Vietnamese food market (My et al. 2017, 2018a, 2021). These standards were introduced in the food market to respond to food safety issues (My et al. 2021). VietGAP is a national GAP standard which comprises cultivation practices that ensures food safety and quality of various crops, including rice, whereas GlobalG.A.P. is a widely applied cultivation practice for agricultural products (My et al. 2017, 2021).

There are agronomic technologies available for farm-level uptake that could help in reducing GHG emissions and increase farmer incomes. For example, in recent years, the Vietnam government has been putting substantial efforts into encouraging farmers to adopt sustainable practices through the implementation of "One Must Do, Five Reductions (1M5R)" (see Chap. 4), a technology package which recommends the use of certified seeds ("One Must Do") and reductions in seed rate, nitrogen application, pesticide use, water use, and postharvest losses ("Five Reductions").

Recent research by Connor et al. (2021a) in Vietnam showed that the main drivers of adopting the whole 1M5R technology package at the farm level are: ease of implementation, education, satisfaction, and non-rice income. It is worth noting that farmers opt to follow selected components of the technology package, with most of them following the requirements on the reductions of pesticide and postharvest loss and the use of certified seeds. On the other hand, they tend to face constraints in adopting the requirements for the use of fertilizer, water use, and seed rate. Farmers reported encountering difficulty in adopting these practices citing challenges such as practices not coinciding with their cropping pattern and weather conditions.

Postharvest. Postharvest "process upgrading" is another entry point for sustainability that can be targeted by focusing on improving practices that reduce losses and contribute to value-addition to farmers and other value chain actors. Reduction in losses incurred could be addressed through improvement in postharvest equipment used for threshing, milling, drying, processing, and storage for grains (see Chap. 4). Needs and opportunity assessments could be conducted in each region to understand underlying gaps in the practices, especially unsustainable practices and to make sure that the technologies and innovations developed are catered to the needs of each area. Postharvest can also include "product upgrading," e.g., if quality-ensuring postharvest technologies like hermetic storage systems or mechanical dryers are introduced to comply with the SRP standard.

Input Provision. The provision of inputs is usually seen as the responsibility of the private sector. This works well for fertilizer and agrochemicals, for which profit margins are attractive enough for companies to engage but is still lacking for quality seeds. The seed replacement rate (SRR) for rice, which is defined as the percentage of area sown out of the total area of crop planted by using certified or quality seeds rather than farmers' own seeds, is typically below 20% in Southeast Asia (unpublished data). Strengthening national seed systems is, therefore, still an important entry point, especially since the use of quality seed is a precondition for maximizing yields and input use efficiency and such important for closing the yield gaps. While working on seed systems was not a formal activity in CORIGAP, CORIGAP scientists have contributed to national efforts, e.g., by promoting hermetic storage systems, especially the Superbag, for public and private seed processors in all countries, developing a concept and business plan for a community seed processing center in Cambodia and providing assistance to community seed centers in Cambodia.

Service Provision. Contrary to new varieties that can be disseminated through existing seed multiplication processing and dissemination channels, the sustainable introduction of machines for fostering mechanization and upgrading postharvest is different. It requires a mix of setting up or supporting an equipment supply chain, financing (see below), and the establishment of training and after-sales services. Machinery that is beyond farmers' reach, this supply chain also requires the design, verification, and piloting of business models for providing a machinery service to farmers, particularly when the technology is new and the benefits are not yet obvious for the end users or contract service providers. Examples from CORIGAP are the installation of flatbed dryers and the business models for farmer groups in Myanmar and Indonesia, and pilots for contract services with laser leveling equipment in Vietnam and Thailand (see Sect. 6.3 for collaboration with the private sector).

By-products. The common practice of burning rice straw left in the field adds to pollution and greenhouse gas emissions (Nguyen et al. 2019; see Chapter 5). However, despite many prohibitions, it remains to be widely practiced by farmers who consider it as waste material. In Vietnam, the improper management of rice by-products, such as rice straw and husk, is one of the key contributors to greenhouse gas emissions (World Bank 2022a). Therefore, diverting by-products to more sustainable uses can be a powerful entry point for increasing the sustainability of value chains, e.g., by developing new products ("product upgrading"), expanding existing markets ("channel upgrading"), and developing new markets ("intersectoral upgrading"), supply chains and processing technologies ("process upgrading") for rice by-products to reduce unsustainable practices (e.g., Nguyen et al. 2016, 2019; Demont et al. 2020). Policymakers can encourage the diversion of straw utilization from unsustainable practices to more sustainable uses, thereby ultimately contributing to the mitigation of climate change. For example, rice straw can be used in many ways, either as an input to other food or non-food value chains such as for mushroom production, fodder production, or as mulching material (Nguyen et al. 2016; Demont et al. 2020).

Contract farming. The more value chains evolve from traditional, fragmented "supply chains" (with many intermediaries operating through arms-length transactions with little coordination) toward value-focused chains that are vertically coordinated by agri-business firms, the more a potential emerges for deploying private governance through vertical coordination (e.g., contract farming, which can be classified under "functional upgrading" in value chain upgrading jargon) as an entry point for internalizing sustainability (Demont and Rutsaert 2017). Through production contracts with farmers, agri-business can govern product quality and practices more effectively. In Africa, farmers sometimes resort to contract farming to access finance (Soullier et al. 2020). Vertical coordination between agri-business and farms engenders transaction costs and, therefore, often requires a critical level of horizontal coordination among farms to generate economies of scale for it to become profitable (Ba et al. 2019), which is illustrated through the case of Vietnam below.

Markets. Consumer demand in end markets is a powerful entry point for "pulling in" sustainable production standards along rice value chains. "Embodying" sustainability in the product (as part of "product upgrading") through labels and encouraging consumers to consume certified sustainably produced rice through product labels and certification is a well-known market-based incentive mechanism for sustainability in value chains (Demont and Rutsaert 2017). Building consumer trust and confidence in sustainable quality standards can be facilitated by using quality labels and certifications as communication tools. Strategies to convey the information to consumers should be effective in providing consumers with comprehensive information on the quality aspects certified by sustainability labels.

Finance. As mentioned, insufficient access to finance often constrains value chain upgrading (Soullier et al. 2020). The availability of financial services along value chains facilitates the adoption of improved production technologies and improves linkages among actors. Making access to finance conditional upon the adherence to sustainable production standards could incentivize value chain actors to comply with these standards (e.g., green bonds).

Policy. Public governance through policy has been traditionally used by governments to incentivize (the so-called carrot) the adoption of sustainable practices and disincentivize (the "stick") the adoption of unsustainable practices. By providing the right mix of incentives and disincentives, farmers can be nudged toward the adoption of sustainable production practices. The CORIGAP predecessor project Irrigated Rice Research Consortium (IRRC) influenced policy informally by making sure that IRRC scientists visited national policymakers during their travel and updated them on project progress, and lobbied for linkages to national programs. The IRRC and CORIGAP also had an advisory committee in which high-level research managers and policy members from all partner countries were represented. There were a few dedicated events for fostering a policy dialogue. In 2007, a seminar was conducted for policymakers in Indonesia. During CORIGAP, seminars targeting policymakers were conducted in Vietnam on laser leveling (2013), hermetic storage (2017), and sustainable rice straw management (2018). Project outputs and outcomes were also communicated to policymakers through the IRRC publication RIPPLE and during CORIGAP, in particular during the final phase through the various communication channels (see Sect. 7.5.1).

The IRRC started as a research project and moved into scaling out with CORIGAP. Influence on policy was significant but could have been larger with more efforts on policy dialogue. New projects should, therefore, include the facilitation of a policy dialogue at the planning stage and also develop an M&E system for capturing the impact on the policy level.

Credit markets. In case rice markets and value chains provide little incentives for embodying and internalizing sustainability, a last resort would be to "disembody" the sustainability claim from the product through credit markets, such as, for example, through carbon credit markets or "Book & Claim" mechanisms (Demont and Rutsaert 2017). The principle is that a credit buyer acquires credits for the sustainable production of rice, which are transferred to certified farmers or agri-business firms that produce the rice and market it through the existing supply chain as conventionally produced rice, i.e., without segregation or identity preservation. This requires little changes in vertical coordination between farmers and agri-business, but the disembodiment of product and production standards entails challenges in terms of building consumer trust.

The entire rice production system can be conceptualized as a socio-technical system in that it includes a network of actors, materials or tools, knowledge, norms, regulations, and standards for behavior (Geels 2004). In a socio-technical system, there is a regime which is the current, widely adopted, or dominant technology, along with the practices and routines that hold it in place (Geels and Schot 2007). The entry points described in Fig. 7.1 target change in aspects of the socio-technical regime. Changes across multiple entry points can enable sustainable practices to become mainstream thereby reconfiguring the current socio-technical regime. When the regime has changed, this entails changes not only in the techniques, tools, and knowledge but also in the social mechanisms that enable its sustained and widespread use.

7.1.2 Internalizing and Scaling Sustainable Production Standards Through Contract Farming

Facing rising labor and input costs, the Vietnamese rice sector can no longer sustain its status as a low-cost, low/medium-quality rice exporter in the international market. Therefore, the Vietnamese government is strategically investing in an enabling environment for vertical coordination in rice value chains with the aim of encouraging value chain upgrading to increase product quality and reduce poverty (Demont and Rutsaert 2017; Ba et al. 2019). Since the early 2000s, the Vietnamese government has been implementing policies that encourage rice exporters to directly engage with farmers through contract farming (as opposed to relying on traders in spot markets). In 2002, Decision 80/2002/QD-TTG was crafted and served as a legal and regulatory framework for contract farming. This policy, however, faced constraints limiting the adoption of contract farming, such as high rates of contract breach, and the policy was not inclusive as it encouraged the participation of large-scale farmers instead of smallholders (Ba et al. 2019). To address the scale bias, in 2013, Decision 80 was revised and augmented by Decision 62/2013/QD-TTG with the inclusion of the "Small Farmers, Large Field" (SFLF) program that aimed at generating economies of scale by encouraging land consolidation and horizontal coordination among smallholder farmers. Decision 62 was designed to address the issues of low adoption and contract breach. In 2018, Decree 98/2018/ND-CP was implemented, which included incentives for farmer organizations that would formally engage in the SFLF scheme. The Vietnamese government further supported a large-scale program of Sustainable Agricultural Transformation (VnSAT). This included institutional strengthening to support agricultural transformation and support of sustainable rice-based systems (World Bank-Vietnam 2016). VnSAT also provided mechanisms by which groups of farmers are incentivized to implement sustainability standards and benefit from these through linkages with contract companies (Flor et al. 2021).

These policies successfully encouraged rice farmers' participation in contract farming. Data show increasing rates of participation in contract farming since 2013 in Can Tho province, where most rice exporters are based. In 2022, the area devoted to contract farming in Can Tho attained 19%, a considerable increase from the four percent rate recorded a decade earlier in 2013 (Table 7.1).

To robustly scale up the implementation of contract farming, it is essential to determine what drives farmers' participation in order to devise strategies for developing inclusive contracts between farmers and exporters. Empirical research by Ba et al. (2019) carried out in the south of Vietnam showed that the main drivers that influence

Table 7.1 Rice farmers' participation in contract farming (CFa) in Can Tho, Vietnam, 2013–2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total planted rice area (ha)	236,539	232,336	237,950	240,023	240,126	237,326	225,143	222,999	222,376	216,385
Area under CFa (ha)	10,304	15,612	17,441	19,107	22,672	29,606	35,368	38,437	39,716	40,465
Area under CFa (%)	4%	7%	7%	8%	9%	12%	16%	17%	18%	19%
Number of households	8,536	9,973	12,933	13,515	15,762	21,061	27,197	27,763	28,072	28,872
Rice volume (t)	68,625	103,976	116,157	127,253	150,996	197,176	235,551	255,990	264,509	269,496
Productivity (t ha^{-1})	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66	6.66

Note Rice volume was calculated by multiplying the area under contract farming by the average yield of 6.66 tons per hectare
Source of data Ms Pham Thi Minh Hieu of DARD Can Tho

farmers' participation in contract farming are: perceived access to secured markets and membership in the SFLF program. Membership in the SFLF program boosts participation in contract farming from 46 to 73%. Other factors influencing participation in contract farming include public training, age, family size, and membership in farmer associations. Conversely, a lack of trust in export firms is a serious hurdle for farmers to engage in contract farming.

In a more recent study, Quilloy et al. (2021) set up a negotiation exercise between farmer groups and export companies to design an inclusive rice farming contract that could encourage farmers to adopt sustainable production standards. The authors found that there needs to be a safe space for both parties in order to negotiate mutually beneficial contract terms. At the end of the negotiation exercise, participants reached a consensus on different contract attributes. Both parties agreed on a seven percent price premium and pre-financing of a package of essential inputs (branded seed, fertilizers, pesticides, and/or credit). Producing medium-quality rice following standards set by export companies was also amenable to both parties. Some heterogeneity on the optimal level of pre-financing was also noted during the workshop; buyers prefer "total" pre-financing (i.e., a fixed package of seed and chemicals), while some farmer participants prefer "partial" pre-financing to allow for some flexibility in the choice of the chemical dose and brands (to reduce input costs). At the end of the negotiation exercise, however, both parties agreed on total pre-financing under the condition that it would be under the control of the farmers' group (indicating a strong preference for farmer sovereignty). It was worth noting that farmer groups and export companies were receptive to the idea of adopting sustainable production standards such as VietGAP and GlobalGAP as long as compliance is rewarded through price premiums.

Underlying these contracts are the enablers wherein techniques, tools, and skills are scaled to many farmers. This, for example, includes the knowledge outreach and sharing of technologies that allow farmers to meet the standards. It also includes the monitoring and peer influences that enable the implementation of sustainable practices. This alignment between knowledge outreach and contract mechanisms creates a push-and-pull approach for knowledge dissemination and scaling of innovations (Totin et al. 2019).

7.1.3 Embodying and Scaling Sustainable Production Standards Through Product Labels and Certification

Rice consumers exhibit different preferences regarding the quality attributes of rice that they consume (Bairagi et al. 2020, 2021; Calingacion et al. 2014; Cuong et al. 2022; Custodio et al. 2016, 2019; Xu et al. 2018). These preferences differ in terms of both extrinsic and intrinsic quality attributes of rice. Rice consumers do not only take into account grain appearance, cooking quality, and sensory characteristics of rice grains (Custodio et al. 2016, 2019) but also put a premium on extrinsic attributes, such as labels and brands (e.g., Bairagi et al. 2020; Cuong et al. 2022; My et al. 2018a, b; Xu et al. 2018). Xu et al. (2018) found that extrinsic product attributes like an informative label on rice packages and brands influence consumers' decisions to purchase. Products featuring informative labels are a main factor influencing consumer purchase of rice and were the second highest rated factor of consumers following the taste of rice. In addition, consumers who have higher incomes are more likely to purchase branded rice. In Vietnam, consumers' perception of extrinsic product attributes such as packaging and labeling and certification affect their decision to purchase organic products (Luu 2019).

In order to encourage the adoption of sustainable production standards, sufficient knowledge of consumer awareness, acceptance, and willingness to pay for products that are sustainably produced need to be analyzed (My et al. 2018a, b). Sustainable production standards are credence attributes which means they only add value if consumers trust them (Barcella et al. 2018), indicating the importance of communicating them through product labels and certifications, which could aid in their purchase decisions (Demont and Rutsaert 2017). When it comes to buying food products, food labeling can serve as an important channel in conveying information to consumers, thereby influencing their purchase decisions (Verbeke 2005; Demont and Rutsaert 2017). With the right packaging, attributes such as quality, traceability, and production practices could be effectively communicated to consumers (Bairagi et al. 2021).

Recent research in Vietnam suggests that if consumers are knowledgeable and are given sufficient information about sustainability, they can recognize the importance of sustainably produced rice and will be willing to pay a premium for it. The study done by My et al. (2018a, b) was designed to draw out consumers' WTP for certified sustainably-produced rice. Using the Becker, DeGroot and Marschak (BDM) auction mechanism, they examined the effects of gradually increasing information levels provided to consumers. The study found strong evidence that consumers put price premiums on sustainable production certification, and the mean values increased as additional information was presented to them. Consumers who are knowledgeable about food quality certification were willing to pay more for quality rice compared to consumers who do not trust the certification system. In other words, consumers have a positive attitude toward purchasing sustainable rice when there is sufficient information about the product. The study also revealed that consumers who read food labels when they purchase food were also found to be willing to pay more for quality rice compared to those who do not always read food labels. In addition, wealthier consumers were also prepared to pay higher price premiums. This is consistent with the findings of some studies in China, which found a positive relationship between the willingness to pay for organic foods and the consumers' purchasing power (Gan et al. 2016; Xu et al. 2018). Consumers who believe sustainably produced rice features health benefits and provides "good value for money" were also found to be willing to pay price premiums.

Connor et al. (2022) conducted a study within the same vein and looked into the perception of consumers about sustainable rice production and knowledge about climate change and determined how these factors influence willingness to pay for certified SRP-labeled rice. The results showed that consumers are willing to pay a

29% price premium for SRP-labeled rice. Consumers' willingness to pay for sustainably produced rice was influenced by their household income and their knowledge about CO_2 and the greenhouse effect. They also added that knowledge about climate change consequences could also be included as a predictor of consumers' willingness to pay for SRP-labeled rice.

More recently, Cuong et al. (2022) investigated how consumers make trade-offs between sustainability and health attributes in their purchase of rice. Using choice experiments, the authors determined consumer preferences and attributes for sustainability and health attributes by using four certification labels, namely, low-emission, eco-friendly, ethically-produced, and low glycemic index. The estimated price premiums were in the range of 28–66%, with the highest premiums recorded for the low glycemic index label and the lowest for the low-emission label. These results suggest that consumers put more value on attributes that affect personal health than attributes that affect planetary health and the welfare of others.

7.1.4 Conclusions

Here we proposed a framework of market-based incentive mechanisms for the adoption and scaling of sustainable production standards throughout rice value chains. We proposed eleven entry points, i.e., breeding, agronomy, postharvest, by-products, contract farming, markets, finance, policy, input provision (seeds), service provision, and credit markets, and reviewed evidence of two mechanisms that have been piloted in Vietnam.

Contract farming can be used to encourage farm-level uptake of sustainability standards in rice value chains as long as participation is inclusive of smallholders. Success also crucially hinges on informing value chain actors of the benefits of sustainable production standards. The case of Vietnam has shown that judicious public governance can trigger private governance of rice value chains, which provides an efficient entry point for "internalizing" sustainability in rice value chains. This further shows an alignment of elements that create a shift in the current socio-technical regime that enables sustainability standards to scale. These elements in the case highlight potential entry points through technical knowledge, incentive mechanisms, coordination and linkages, markets and regulatory mechanisms.

Consumers, especially in the international markets, are developing preferences for products that meet sustainable production standards. They are increasingly becoming health and environmentally conscious, more knowledgeable about production standards and exhibit demand for extrinsic quality attributes. Rice value chains can tap into these economic opportunities by adding value to products through product upgrading. To capture the market share for sustainably-produced products, consumers need to be adequately informed about their benefits. Labels and certifications can be used as communication tools to respond to the emerging demand for sustainably produced products, and messaging can focus on climate change as the most salient reason for change.

Moving forward, it will be important to build market-based mechanisms to reward value chain actors for adopting sustainable production standards. Policymakers and value chain actors can simultaneously target multiple entry points along rice value chains with multiple upgrading strategies (e.g., product, process, functional, channel, and intersectoral upgrading). Depending on the context, the challenge will consist in finding the "optimal" investment portfolio of upgrading strategies along the "pull" and "push" continuum that maximizes the sustainability of rice value chains. Breeding is an obvious first upstream entry point for "pushing" sustainability throughout value chains by ensuring varieties are developed that are market-driven, gender-intentional, and climate-resilient. There are varied actors that influence agronomic practices of farmers. Here, contract farming is an important coordination mechanism for ensuring knowledge outreach, enabling access to technical support, and the regulatory aspect for sustainability standards. Further, the more rice value chains are "pulled" by downstream consumers thanks to increasing incomes and stringent standards in international markets and buyers that are conscious about social and environmental challenges, the more "embodying" sustainability through product upgrading has a chance to pay off and subsequently incentivize upstream process upgrading at farm level and beyond. Market studies with both domestic and international consumers have to be conducted to assess the level of "pull" incentive for downstream rice value chains that can be generated in these markets. The more rice value chains are vertically coordinated, the more potential exists for "internalizing" sustainability mid-stream through private governance if agri-business firms can be incentivized (e.g., through downstream consumer demand for certification) to invest in sustainable production standards. The higher the levels of marketable surplus and spatial consolidation of the supply of rice and hence its by-products (which is typically the case in the Asian Mega Deltas), the higher the potential for intersectoral upgrading ("push") by developing markets and supply chains of by-products to divert unsustainable practices toward more sustainable uses. Hence, as rice value chains develop, entry points for sustainability naturally emerge following a trajectory from process upgrading to product upgrading and further to functional, channel, and intersectoral upgrading. In other words, there is no one-size-fits-all and future research needs to be conducted to determine the optimal policy mix that can accelerate rice value chain upgrading toward increasing sustainability.

7.2 The Evolution of CORIGAP Data Collection Mechanisms for Monitoring and Evaluation, Learning, and Assessment of Changes

The CORIGAP project has implemented best management practices and technologies in its partner countries to improve food security and gender equity and to alleviate poverty through improved production and sustainable natural resource management. Such ambitious outcome targets require that all key stakeholders contribute to achieving desired results and have aligned their tools and processes in monitoring performance indicators. To effectively monitor and evaluate project interventions, it is imperative to capture high-quality data in a timely and coordinated manner. This enhances the support for informed decision-making for national partners and policymakers.

Qualitative and quantitative methods are equally essential tools for collecting information. Qualitative data collection tools include online forums, in-depth interviews, and focus group discussions collecting non-quantifiable information, such as feelings, perceptions, and reasons. Quantitative data collection, however, gathers measurable information and is administered through face-to-face, online, mail, or phone interviews. Traditionally, data collection was conducted using pen-and-paper personal interviews (PAPI). With technological advancement, data collection evolved quickly and made computer-assisted personal interviews (CAPI) more popular.

Household surveys were conducted at various intervals to gather a comprehensive set of socio-demographic and agronomic data of farmer groups operating in lowland rice ecosystems. This data-led activity provides estimates of changes in practices, input costs, production, and perceptions before, during, and after project intervention. The team conducted baseline, midline, and end-line household surveys in Myanmar, Thailand, Vietnam, and Indonesia between 2014 and 2022. The baseline surveys were implemented before introducing the interventions. In contrast, the midline surveys were completed five years into the project, and the end-line surveys were conducted after seven years of uptake. In addition, cross-sectional single-point surveys were also conducted in Vietnam, Thailand, Myanmar, Indonesia, and China to investigate farmers' perceptions of change due to technology and practice adoption.

In 2012, we used pen-and-paper personal interview (PAPI) for the baseline data collection in Myanmar. However, for the remaining surveys, covering baseline, midline, end-line data periods, and cross-sectional surveys, computer-assisted personal interviews (CAPI) were used. CAPI is a method of collecting data using tablets or smartphones. In the following part, we will share the lessons learned from the experience of collecting data via PAPI and will also cover the learnings from the Irrigated Rice Research Consortium (IRRC) project, which preceded CORIGAP and had similar project interventions, funded by the Swiss Agency for Development and Cooperation (SDC).

7.2.1 Case 1: Pen-and-Paper Personal Interview (PAPI)

The process of paper-based data collection we used in our household surveys is illustrated in Fig. 7.2. The process started with designing and printing the survey questionnaires. Designing questionnaires involved inputs from different scientists and National Agricultural Research and Extension Services (NARES) partners. The questionnaire was translated into the local language of the survey sites. Measurement units were adjusted to local measures (e.g., pyi instead of kg in Myanmar). Pre-testing

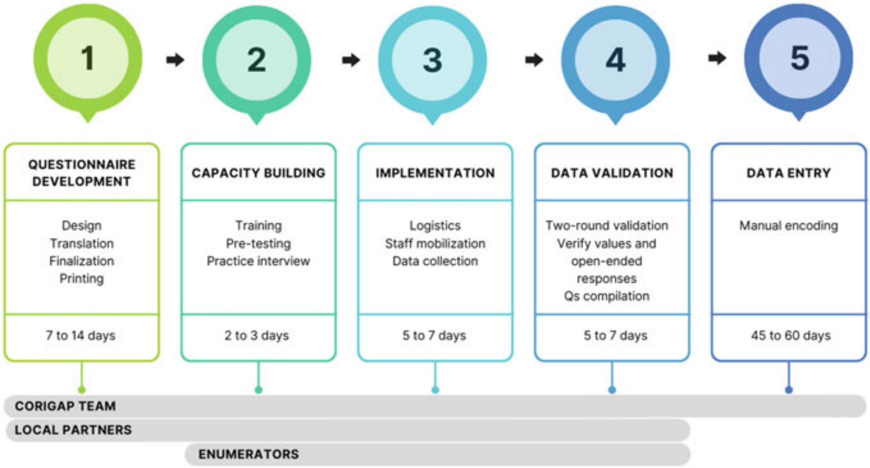

Fig. 7.2 Data collection and quality control using PAPI

was conducted to ensure that all necessary information was captured and unnecessary questions were excluded. Pre-testing ensures that the questions are appropriate for the culture and context of the country where the survey is being conducted. Designing and finalizing the survey questionnaire took one to two weeks. Following this, the interviewers' training was conducted, typically taking two to three days. It was important that the team and interviewers had a clear understanding of each question. We spent one whole day discussing the details of the questionnaire to ensure all had the same understanding and definition of the questions. Furthermore, half a day was allocated to practice interviews. The training of interviewers allowed us to pre-test the questionnaire on-site and to make any necessary changes identified during the practice interviews.

Once interviewers were familiar with the questionnaire and any necessary adjustments had been made, the data were collected, which typically took 10–15 days. The first two to three days of data collection were the most critical as interviewers were still adjusting to the process. Therefore, data editing was conducted daily during the first days of the survey implementation to ensure that all interviewers understood the questions and that all issues that arose during this time were addressed.

The data collected included information on the farmer and their farm, agronomic and postharvest practices, production (yield), and related costs and income. Additionally, we collected information on farmers' knowledge, attitudes, and practices on irrigation and pest management. Data editing could take two rounds, including verifying values and translating open-ended questions. The questionnaire paper was collected and marked as edited once verified as complete and correct.

However, in some cases, the questionnaires needed to be returned to interviewers for verification and correction of extreme values or missed translation of answers into English. A second round of editing was conducted once all issues were resolved.

The entire process of data collection via PAPI, from data collection to questionnaire compilation, took 10 to 15 days. The questionnaires were then transported back to the IRRI headquarters for manual data entry, which took up to two months to complete. Historically, the entire data collection process via PAPI could take up to 90 days. The CORIGAP surveys were implemented by CORIGAP staff and local partners who served as coordinators and enumerators.

Advantages of PAPI. Pen-and-paper interviews are typically cheaper to design than computer-assisted interviews, as they do not require expensive computer equipment or software. Pen-and-paper interviews can be conducted in any location and do not require computer, tablet, phone, or internet access. This makes pen-and-paper interviews more accessible to participants who may not have access to technology or may be uncomfortable using it.

PAPIs are generally more straightforward to administer, as they do not require specialized training or technical expertise. They may yield more complete and detailed answers from participants, as they are not limited by the constraints of a computer interface. The interviewer can easily write down information on the paper questionnaire without restriction. Another advantage of PAPIs is that they can be modified or adapted on the fly, whereas computer-assisted interviews are more rigid and require advanced planning. This also allows flexibility whenever specific questions have to be added or revised. Lastly, PAPIs do not pose the same risk of data security breaches as computer-assisted interviews, which can be vulnerable to hacking or other cyber threats.

Disadvantages of PAPI. PAPI can be more time-consuming and labor-intensive than electronic methods, specifically in entering the data manually and interviewing the respondents. Entering data manually can take months, depending on the number of variables collected. Long questionnaires can cause survey fatigue to both respondents and interviewers. Another drawback of PAPI is the transport of forms from other countries, which can be expensive and risky as they could get lost or damaged. At times it was risky when we transported the questionnaires locally, especially in areas that used waterways. PAPI is more prone to human error, such as transcription (WorldBank 2022b; PaperSurvey 2019) and calculation which significantly affects the quality of the data collected. PAPI data collection is expensive as it includes supervising the interviewers, traveling, accommodation, printing questionnaires, and other related expenses in implementing the PAPI.

Issues, Impact, Solutions, and Lessons Learned. In the early part of the IRRC years (2005), we spent one to two days in each study site to discuss the activity with our local partners (who would help us train the interviewers) and to train interviewers by explaining the goals of the survey and the details of each question. This was done to ensure that the partners and interviewers had correct interpretations of the questions and a full grasp of why we were doing the surveys. We conducted simulation interviews among enumerators and then left the data collection to the local partners as part of our collaboration and capacity-building arrangements. Monitoring the progress of the data collection in the field and assisting interviewers and local partners with any issues encountered in the survey was difficult. Communication was only possible via email, and the internet connection in the partner country was relatively poor during those days.

Consequently, some erroneous data were collected. Data validation was only possible after the local partners entered the data and shared them with us via email. Poor internet connection caused communication delays with the partners whenever we needed to clarify data. In one instance, we learned that the local partners had another task of training the farmers to use a farmer diary to record their activities, related costs, and income on another project. This resulted in mixing up the two activities, and in one instance, farmer diaries were used instead of the household survey. All of the issues, as mentioned earlier, may have resulted from a lack of familiarity with the type of data we needed and different confusing scenarios that popped up during survey implementation. In one instance, we also lost hard copies, which were stored in the respective country, but due to office relocation, the hard copies were thrown away. This calls for more rigid data handling and storage practices that need to be unified across countries.

To avoid having similar problems in the following surveys, a decision was made that staff from IRRI headquarters would stay in the field throughout the entire survey duration to monitor and address survey issues such as misinterpreted questions and unexpected scenarios with farmer respondents. Data validation was conducted daily for the first three days of the survey and every two to three days after that to prevent delays in verifying extreme values via email and to allow verification and correction of wrong information while still in the survey sites. Staying in the field until survey completion also warrants proper and secure storage of filled questionnaires.

After several years of conducting PAPI in different countries, training interviewers remains an essential activity in data collection to minimize data problems. Although we allocated more time to training local interviewers, there were cases where we encountered erroneous data during the first few days of survey implementation. This was often due to incorrect conversion of units, collecting the total cost spent on inputs rather than the per unit cost, or adding extra zeroes. Therefore, it is crucial to ensure that the partners helping to train the interviewers clearly understand the purpose of the survey and the questions. Misinterpreted or questions that could be misinterpreted were explained, and each interviewer was closely monitored to avoid similar problems in the future.

Another area of improvement of the PAPI process was in the logistical aspect of data collection. Sometimes, more participants were sampled than needed, and in other instances, fewer participants were recruited due to misunderstandings in communicating with local partners organizing the surveys. When more farmers were invited, the interviewers had to work faster to ensure that all farmers on the site were interviewed, which may have affected the quality of their interviews. Similar logistical problems occurred when the number of survey days was shortened, forcing the interviewers to collect the same amount of data in less time.

7.2.2 *Case 2: Computer-Assisted Personal Interviewing (CAPI)*

Technological advancement brought us to computer-assisted personal interviewing (CAPI), which allows real-time data entry and embedded calculations while collecting data. Figure 7.3 illustrates the flow of data collection and quality control that was implemented using CAPI. Several CAPI software emerged. The SurveyBE (version 3.1.4918) was the first CAPI software we used in collecting baseline household data in Thailand, Indonesia, and Vietnam from 2012 to 2015. Afterward, we used CommCare (version 2.52.1) to collect midline and end-line household survey data from 2017 to 2022, as well as for the cross-sectional surveys. Questionnaire development could take up to 45 days in SurveyBE and CommCare, depending on the length of the questionnaire and the logical skip functions embedded. Both softwares allow multiple languages, which helps interviewers to record the correct information. It also saves time to have all questions translated into the local language before pre-testing. Back translation is equally crucial to ensure questions are translated correctly. App building requires internet access for both SurveyBE and CommCare. Embedding skip logic, validations (i.e., allowing only a reasonable range of values for specific variables), calculation, and hint messages are among the useful features for quicker and more accurate data collection. Once the app was built and translations were completed, pre-testing of the survey application took place to check for errors and fix bugs, ensuring a smooth data collection process. Once the app was running well, the training of interviewers followed. Training of enumerators allowed us to pre-test and revise the survey application if needed. During the training, we encouraged interviewers to discuss any issues they found during the pre-testing, so we could address them before starting the implementation.

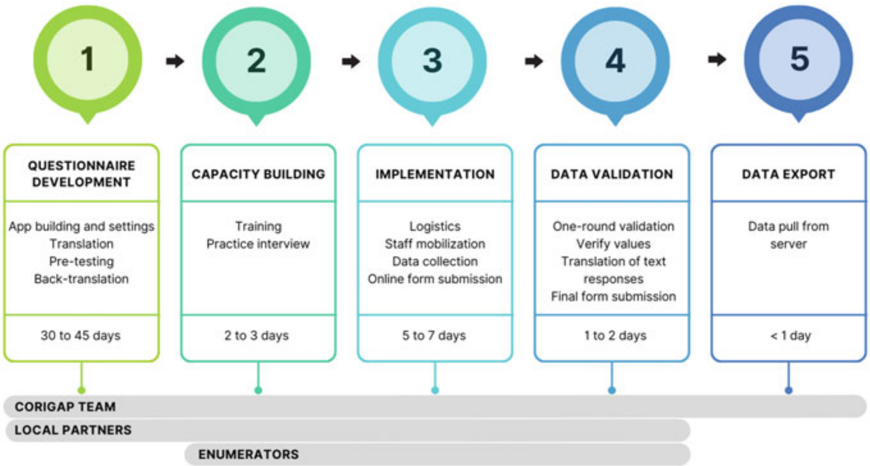

Fig. 7.3 Data collection and quality control using CAPI

To facilitate the training process, a training manual was created. This manual guided enumerators through the process of using the survey applications. This manual was also used to train the local enumerators remotely in 2021, and early 2022 for the end-line surveys in Indonesia and Vietnam when traveling was restricted due to COVID-19. As discussed before, the first two days of the survey implementation were the most crucial days to address errors and issues that may arise. Interviewers were always advised to review the filled-out survey questionnaires (called "forms" in CommCare) carefully before submitting the data. Data editing was conducted on the same day the data were collected to make sure that interviewers were fully able to use the survey application and that questions were interpreted correctly. Afterwards, data editing was conducted every two to three days to verify and discuss extreme values and translate open-ended answers to English. While data collection could be conducted without an internet connection, the submission of forms/questionnaires, on the other hand, required internet access. This means data can be collected in very remote areas, and forms could be uploaded as soon as the internet was available again. Data were exported to Excel to be reviewed by CORIGAP staff. Data were validated and subsequently updated on the validation days. The data of the validated survey questionnaires were exported and prepared for data formatting and analysis using statistical software such as SPSS and Stata.

Advantages of CAPI. CAPI allows efficient use of time and resources when collecting data. CAPI software systems facilitate data entry and checking of errors simultaneously, which saves time and costs and ensures that good quality data are collected. The calculation, validation, skip-loops, and multiple languages are built-in into the CAPI applications ensuring high data quality. It allows the collection and export of data in real time. Furthermore, CAPI provides flexibility in amending and updating the survey questionnaire while in the field. The use of portable gadgets such as phones and tablets provides easy facilitation in the field and obtaining data in real-time; it further minimizes the risk of losing data. The use of CAPI for our monitoring and research processes has provided high-quality data in a very short time. This has enabled us to run several questionnaires in very short periods of time and decreased time and resources significantly.

Disadvantages of CAPI. We would, however, also like to highlight some difficulties and disadvantages that we have encountered on our journey through the different survey applications. The need to invest in tablets, smartphones, and computer software is costly, but in the long term, this investment can be used for subsequent research. Intensive training of interviewers is needed in areas where people are not yet very familiar with the use of electronics, and it can be very challenging. For several surveys, we collaborated with local universities to overcome this problem. Another disadvantage is the size of screens on mobile phones and tablets; if a survey requires the use of pictures that will need to be shown to farmers, it can be challenging due to difficulties seeing. Therefore, it is advisable to have print-outs available as well.

Issues, Impact, Solutions, and Lessons Learned. When we started our monitoring activities, we encountered some issues with our translations, especially when they were provided by people unfamiliar with the agricultural context. We, therefore, made sure that all our questionnaires were always back-translated by an independent translator and checked by a local agricultural specialist.

Due to our limited knowledge when we started using CAPI tools, we encountered some issues while building the survey applications. For example, in one of our surveys, we used a complex loop question design that caused occasional difficulties for the tablets during interview sessions. Another example where we faced difficulties was embedding calculations that also caused tablets to freeze or shut down during interviews. These difficulties eased with time and further knowledge acquisition.

Data editing is much simpler with CAPI since the data collected can be viewed immediately. However, it becomes challenging when not all interviewers submit their collected data on the scheduled form submission. Data editing becomes more difficult when many open-ended questions need a translation. Lastly, an unstable internet connection poses difficulties when uploading and validating data. Therefore, we decided to have a back-up internet connection or conduct data validation on sites with a stable internet connection throughout the day.

7.2.3 Conclusion—Lessons Learned/Moving Forward

In conclusion, pen-and-paper personal interviews and computer-assisted personal interviews have advantages and disadvantages when collecting data. PAPI is typically cheaper to administer and can be conducted anywhere, but uses a lot of human resources. IT is prone to human error and can be more time-consuming and labor-intensive. PAPI is more applicable when collecting qualitative data as an alternative to recording interviews. On the other hand, CAPI is efficient in terms of time and cost, but it requires investment in equipment and software and is dependent on internet access.

The CORIGAP team experienced several challenges when collecting data via PAPI and CAPI. Still, we surpassed these challenges by implementing strict monitoring, conducting pre-testing, and regularly communicating with local partners.

Based on the issues and lessons learned from the CORIGAP surveys, it is recommended to consider the following when conducting future data collection:

- Allocate ample time for training local interviewers to minimize data problems. Proper training of interviewers is crucial in ensuring accurate and high-quality data.
- Ensure that the logistics should be well-planned and details of the surveys are well-communicated to the local partners to avoid issues such as having too few or too many respondents and last-minute changes in survey schedules.
- Back translation should be done independently to ensure the accuracy of translated questions.
- Invest in advanced features of CAPI software and allow reasonable time for testing survey applications, testing conducted by national partners is advisable.

- Strict monitoring of interviewers is needed to address any issues that may arise during the survey.
- Have interviewers note down any issue or relevant information every day to facilitate data validation.
- Data validation should be done regularly to ensure the accuracy and completeness of data.
- Be prepared for an unstable internet connection when using CAPI for data collection and have contingency plans in place.
- Have a contingency plan for unexpected application errors when using CAPI.
- Consider using PAPI and CAPI methods to balance the advantages and disadvantages of each method.
- Lastly, have a clear understanding of the goals and objectives of the survey to ensure questions are aligned with the goal of the survey.

7.3 Evaluating the Adoption and Contributions of CORIGAP-Promoted Technologies in Rice Production: Case of Vietnam, Thailand, Indonesia, and Myanmar

The CORIGAP project offered environmentally sustainable, climate-smart best management practices and technologies developed using new science-based tools combined with a participatory research approach. Specific management practices and technologies were provided to smallholder farmers in the irrigated rice systems to help increase rice production with fewer resources, materials, and costs, reduce negative environmental consequences, and to improve social, economic, and environmental sustainability. Increasing the profitability of rice farming due to the increase in yield and reduced cost of rice production is one of the expected outcomes of the CORIGAP interventions. The CORIGAP project has run for nine years with a target of 500,000 farmers across six Asian countries and has reached more than 758,196 farmers as of December 2020 (CORIGAP 2022). In this section, we will focus on four CORIGAP countries, namely Indonesia, Vietnam, Thailand, and Myanmar.

Every project and program has a life cycle of different stages, including planning, implementation, monitoring, and closure. These stages can be further defined depending on the content of the project or program. The CORIGAP project has undergone three funding phases. Each led to revisiting the Theory of Change (TOC), adjusting and redefining outcomes and outputs to assess and quantify the changes over time. Therefore, a monitoring and evaluation (M&E) component was crucial to the project. The CORIGAP project builds on the impact pathways of the Irrigated Rice Research Consortium, a long-term project that was implemented over 16 years. Rejesus's et al. (2013) impact assessment recommended investigating the heterogeneity of impacts across different groups of farmers accounting for several intersecting factors such as gender, age, and other rice stakeholders. Using different methodologies to assess changes and examine economic and sociocultural impacts is recommended, enhancing consistency in evaluations and monitoring the take-up and adoption numbers more carefully.

Different methods are described in the literature to monitor and evaluate changes and impacts. In general, methods can be categorized into qualitative and quantitative approaches. Project TOCs usually define key performance indicators. CORIGAP employed a combination of qualitative and quantitative approaches to assess changes due to technology and management adoption over time. A monitoring system was designed and implemented in four CORIGAP countries (Indonesia, Thailand, Myanmar, and Vietnam). The M&E system aims to determine the contribution of CORIGAP interventions to predefined outcomes. Furthermore, an effective M&E system is crucial to assess the progress of the implementation of project activities, identify bottlenecks affecting the project performance, and determine necessary steps to overcome problems. M&E systems provide a better understanding of what is happening on the ground, factors affecting the success of project implementation, or why things did not work.

The following paragraphs will describe a detailed description of CORIGAP's monitoring and evaluation activities. Furthermore, this section will also provide an evaluation of changes, quantitative and qualitative assessments, and lessons learned over time.

7.3.1 Monitoring of Farmers Reached in Each CORIGAP Country

As part of the CORIGAP M&E activities, each country was asked to monitor the number of farmers who reached the yield and profit increase in percent. Table 7.2 shows the target and achieved numbers. Overall, the project has reached and, in most countries, even exceeded the project targets. This would not have been possible without the country partners' engagement and additional sources of funding. In Vietnam, for example, the Vietnam Sustainable Agriculture Transformation Project (VnSAT) funded activities that supported 1M5R with US$150 million. The VnSAT project was implemented by the Ministry of Agriculture and Rural Development (MARD) and focused on institutional strengthening to support agricultural transformation and support for sustainable rice production. Therefore, the VnSAT project provided technical and financial support to farmers and millers/processors (Flor et al. 2021). Farmers were supported with training and field demonstrations. Furthermore, grants were provided to support the multiplication of certified seeds, investing in postharvest loss reductions and improving small-scale infrastructure such as roads, electricity, and water pumps which improved irrigation. The MARD incorporated its national strategies into the VnSAT project, which meant that 1M5R was embedded in the project and subsequently scaled through technology demonstrations and training of farmers' cooperatives across the Mekong River Delta. Farmers were encouraged to adopt 1M5R, and after targets were reached, the cooperatives would qualify for project investments and had to develop a business case to operate and benefit from the facilities and infrastructure to receive the funds (Flor et al. 2021). Therefore, the number of farmers in Vietnam reached in the provinces where CORIGAP was implemented exceeded the original target significantly.

Similarly, in China, a World Bank project, "Guangdong Agricultural Non-point Source Pollution Control Project," was implemented from 2014 to 2018 in the cities of Huizhou, Jiangmen, and Heyuan in Guangdong province. Three main strategies were determined and focused on (1) pesticide pollution, (2) chemical fertilizer pollution, and (3) farm waste pollution (livestock and poultry waste control). Regarding chemical fertilizer pollution, the 3CT was applied (Sect. 2.5). The technology aims to incentivize farmers to apply less nitrogen fertilizer, at specific times per season. Demonstration sites for pesticide and chemical fertilizer pollution control, as well as the implementation of pollution control measures, were performed (personal communication). The project started with 12,000 farmer households and reached 140,000 households in 2018, establishing a system of active participation. A complex incentive-based system has been developed mostly as part of the World Bank project. Farmers' involvement in the project was monitored electronically. Farmers were asked to sign a contract of participation outlining the conditions and received an electronic identity card that was used to monitor fertilizer and pesticide purchases in certified agricultural stores. Farmers were only allowed to buy certified products, which were complete mixtures of fertilizer and pesticides with low environmental toxicity. Farmers bought these products at reduced costs when using their personal

Table 7.2 The target and achieved number of households reached by country during CORIGAP up to December 2020

Country	Households reached		Yield and profit increase (target 10%)		Focal districts	
	Target	Achieved	Yield (%)	Profit (%)	Target	Achieved
China	100,000	320,000 *400,000*	11.0	21.3	8	6
Indonesia	90,000	172,000	Yogya 13 Sth Sum > 20 Nth Sum—low elev 9 high elev 90	Yogya 17 Sth Sum 30 Nth Sum—low 21 high 90	6	8
Myanmar	10,000	> 25,000	13.3	30	4	71
Sri Lanka	20,000	17,200	4 to 20		5	2
Thailand	30,000	18,000	1	15	4	8
Vietnam	250,000	231,329 *250,000*	7.8 *10*	28.3 *28.6*	8	8
Totals	**500,000**	**758,196**			**31**	**103**

Estimates of associated increases in yield and profit for smallholder farmers are shown. These figures were provided by each country
Note Yogya = Yogyakarta, Sth Sum = South Sumatra, Nth Sum = North Sumatra, elev = elevation

ID cards. Shopkeepers would get the difference in price between certified and non-certified products reimbursed through the World Bank project. Additionally, shopkeepers were obliged to provide information about the project to the farmers and actively disseminate information material. The education of farmers was provided through village technicians, often farmers themselves, who had already adopted the new technologies. Village technicians were paid to provide the training. There were incentives for the farmers and also for the whole village if they participated. This, in turn, helped the CORIGAP project to exceed its target in China.

7.3.2 Quantitative Assessment of Changes Through Baseline and End-Line Surveys

The following section will describe the monitoring processes at the household level to investigate how farmers' practices changed with adopting technologies and climate-smart management practices and how this behavior change affected the cost of producing rice, yield, and income of smallholder farmers and their communities. The changes in key indicators over time between adopter and non-adopter farmers will be measured and evaluated using descriptive statistical analyses and the difference-in-differences (DID) method. DID measures the differences in outcomes for the program participants before and after the program relative to non-participants. The study defines the program participants as adopters of CORIGAP interventions. It must be noted that in each CORIGAP country, multiple interventions took place simultaneously. For instance, the project introduced postharvest technologies, such as combine harvester, stripper harvester, multiple storage solutions, or straw management technologies. Another set of technologies includes water-saving technologies and nutrient and pest management practices. These instances resulted in a complex system with overlapping activities addressing multiple outcomes. The quantitative data analysis included only selected interventions with sufficient adopters suitable and valid for statistical analyses. Lessons from this section may be referred to for similar interventions and donors focusing on similar and multidimensional development projects.

7.3.2.1 Household Survey Design and Implementation

Household surveys were conducted in three periods to measure the changes in farm management practices, production costs, yield, and farmers' perceptions before, during, and at the end of the project. The data collection of the CORIGAP project was initially planned to be conducted at two points in time: baseline, before any interventions were introduced, and at end-line after four to five years of implementation. When CORIGAP was extended for a third phase, a third round of data collection was also initiated to understand more about the changes resulting from the

CORIGAP interventions in Vietnam and Indonesia. Therefore, the respective surveys were labeled baseline, midline (after four to five years), and end-line surveys (after eight years). For the other two countries, it was impossible to conduct a third survey due to Myanmar's political situation and Thailand's small sample size and ongoing COVID-19 restrictions.

The information collected from household surveys includes agronomic practices, labor and material inputs costs, rice yield, knowledge, attitudes, and practices on land preparation, rice cultivation, harvesting, and postharvest. Furthermore, newly developed measures were included in the end-line. These measures capture the impact of CORIGAP on the economic aspects and farmers' perceptions of social and environmental changes after adopting CORIGAP practices and technologies (see Sect. 7.4).

The baseline surveys in Myanmar were conducted using pen-and-paper assisted personal interviews. All other household survey data were collected using computer-assisted personal interviews. Baseline data in Thailand, Indonesia, and Vietnam were collected using the SurveyBe application (version 3.1.4918). Midline and end-line surveys were implemented using the CommCare application (version 2.52.1).

For all countries, purposive sampling was applied at the village level to examine the contribution of the CORIGAP interventions to its target beneficiaries. The treatment village selection was based on the needs assessment, cropping system, and location of the CORIGAP activities. The control villages were purposively selected for having similar geographical characteristics to the treatment sites. They were selected at a distance from the treatment sites to avoid diffusion effects of the intervention. Random sampling was applied at the farmer level in each country. Farmer lists were provided by the country partners.

Myanmar. The baseline household data in Myanmar were collected in eight villages of Daik-U Township, Bago Province, in August 2012. The treatment villages were Ka Doke Phayar Gyi, Oat Shit Kone, Pha Aung Weh, and Kyaik Sa Kaw. The control villages were Myo Ma, Mau Tan, Shwe Inn Done, and Doe Tan. The survey was stratified between rice-rice and rice-pulse cropping systems with 100 farmers per system (Table 7.3). For each cropping system, 50 farmers were interviewed from the treatment and control villages. Staff from the Department of Agriculture (DoA) collected the data. The data collected covered wet (June to October) and dry (December to April) seasons.

Indonesia. The baseline household surveys in Indonesia were conducted in the Special Region of Yogyakarta (two treatment villages and two control villages) in May 2014. The treatment villages were Jogotirto and Madurejo, while the control villages were Srimulyo and Bokoharjo. A total of 180 farmers were interviewed, 50 each from the two treatment villages and 40 each from the control villages (Table 7.3). The staff of BPTP provided the list of farmers and collected the data. Both wet (December–March) and dry (April–July) seasons were included.

Thailand. The baseline household surveys were conducted in the province of Nakhon Sawan in June 2013. A total of 84 farmers were interviewed in four villages; the treatment sites were in Nongjikree ($n = 24$) and Sapansong ($n = 20$), and Sakaengo ($n = 21$) villages. The control villages were in Pacluk ($n = 19$) and Sakengo

Table 7.3 Summary of household surveys conducted in CORIGAP countries from 2012 to 2022

	Country			
	Myanmar	Thailand	Indonesia	Vietnam
Baseline				
Province	Bago	Nakhon Sawan	Yogyakarta	Can Tho
Sample size	200	84	180	180
Treatment	100	44	100	100
Control	100	40	80	80
Data collection (Month/Year)	Aug/2012	June/2013	May/2014	June/2015
Midline (after 5 years)				
Province			Yogyakarta	Can Tho
Sample size			203	183
Treatment			98	105
Control			105	78
Data collection (Month/Year)			Sept/2018	Sept/2019
End-line (after 8 years)				
Province	Bago	Nakhon Sawan	Yogyakarta	Can Tho
Sample size	171	84	173	156
Treatment	82	44	94	86
Control	89	40	79	70
Data collection (Month/Year)	Aug/2017	March/2019	Nov/2021	March/2022

($n = 21$). The farmers interviewed belong to the Community Rice Center. The data collected covered wet (July–October) and dry (December–March) seasons.

Vietnam. Baseline household surveys were conducted in four communes of Can Tho in the Mekong River Delta, Southern Vietnam, in 2015. A total of 180 farmers were interviewed from Thanh An ($n = 50$) and Thanh Loi ($n = 50$) as the treatment sites and from Thanh An ($n = 40$) and Thanh Thang ($n = 40$) as the control sites. The survey covered two seasons, the winter-spring data, which starts in November and lasts until March, and the summer-autumn season which covers the months of July to October.

7.3.2.2 Midline Household Surveys

The midline household surveys were implemented to monitor the preliminary changes in farmers' practices in the midterms of the project intervention. Monitoring the changes in practices allows a better understanding of how the intervention affects smallholder farmers' production costs, yields, and incomes. The midline survey contains the same questions as the baseline survey and is implemented in Indonesia and Vietnam.

Indonesia. The midline household surveys in Indonesia were completed in September 2018 using the CommCare application. A total of 172 farmers were interviewed from the same list of farmers in the baseline (Table 7.3); 98 respondents were from Jogotirto and Madurejo, while 74 were from the villages of Srimulyo and Bokoharjo. The same local partners from AIAT who helped collect baseline data gathered the midline data. Farmers not interviewed were either too old, deceased, or not in the villages at the time of the survey.

Vietnam. Midline household surveys in Can Tho, Vietnam, were completed in September 2019. A total of 179 farmer respondents were interviewed from the original list of respondents in the baseline survey (Table 7.3); 127 were the same farmers interviewed in the baseline household surveys, while 52 were new farmers. The local partners decided to interview new farmers in communes where some farmers from the list of respondents in the baseline were not available at the time of the midline survey. Out of the total respondents in the midline, 105 were from Thanh An Town and Thanh Loi, while 78 were from Thanh An and Thanh Thang. Most of the local partners who collected the baseline data participated in the midline household survey.

7.3.2.3 End-Line Household Surveys

The end-line household surveys were conducted as a monitoring tool to assess the potential impact of adopting CORIGAP best management practices and technologies on the practices of farmers, which are reflected in the use of inputs, cost, yield, and income. The goal was to interview the same farmers. However, this was not possible in a few instances because they had moved, were too old, or were deceased. Therefore, in some instances, replacement farmers were interviewed. The survey was implemented using the household survey app built using the CommCare platform. The design enabled comparisons in yield and income before and after implementing best practices and new varieties, with and without the new practices.

Myanmar. The end-line household surveys in Myanmar were completed in August 2017. Kyak Sa Kaw village was replaced by Pyin Mah Lwin village as a treatment site. Pyin Mah Lwin replaced Kyak Sa Kaw due to changes in the local government structure, which affected the implementation of the CORIGAP activities. A total of 171 rice farmers were interviewed; 82 were from treatment and 89 from control villages. The data were collected with the help of the local DoA partners in Daik-U.

Indonesia. The end-line household survey was conducted in November 2021; a total of 173 respondents were interviewed, with 94 farmers from treatment and 79 farmers from control villages. The training of interviewers and the supervision of the surveys were all done virtually due to the COVID-19 pandemic. The same interviewers from the AIAT in Yogyakarta helped to collect the data.

Thailand. The end-line household survey was conducted in March 2019. A total of 72 farmers were interviewed; 41 were from treatment, while 31 were from control sites. Some of the farmers that were not interviewed have shifted cultivation to growing sugarcane. The data were collected in partnership with the Chainat Rice

Research Center. The interviewers were students of The Nakonsawan College of Agriculture and Technology.

Vietnam. The training of interviewers and end-line household surveys was conducted in March 2022. The activities were supervised virtually by an IRRI HQ staff because of COVID-19 and travel restrictions. A total of 156 farmers from the list of farmers in the baseline survey were interviewed; 86 were from treatment communes, while 70 were from control communes. The staff from DARD in Can Tho helped us collect the end-line data.

7.3.3 Methodology Used to Assess Changes in Outcomes

To examine the changes in outcomes and farm management practices between the survey periods, we consider the DID method. The difference-in-differences method is a quasi-experimental approach that compares the changes in outcomes over time between a population enrolled in a program (the treatment group) and a population that is not (the comparison group). In this study, we focused on the adoption and non-adoption status of the respondent toward the CORIGAP interventions instead of the treatment and control grouping. The non-adopters of the proposed intervention represent the comparison group. The data collected for this study satisfies the requirement for applying the DID method, where there are available data on outcome indicators in the group that adopted the intervention and the group that did not receive the intervention, both before and after the introduction/dissemination of the CORIGAP intervention. Statistically, the DID is usually implemented as an interaction term between time and group dummy variables in the regression model below:

$$\mathrm{Y} = \beta_0 + \beta_1 * [\mathrm{Time}] + \beta_2 * \left[\mathrm{Group}\right] + \beta_3 * \left[\mathrm{Time} * \mathrm{Group}\right] + \varepsilon$$

In this regression model, Y represents the outcome of interest on which change is being measured. In the study, we considered farm management factors (inputs), yield and income. The βs are estimated coefficients and ε the error term. Figure 7.4 shows a graphical illustration of the DID method. The calculation and interpretation of the coefficients in the DID model are shown in Table 7.4. In our analysis, the coefficient of interest is β_3, which is the interaction of group and time or the difference in the changes over time between adopters and non-adopters.

As stated above, the treatment and control villages were assigned. However, prior to the midline and end-line surveys, some of these interventions were disseminated by other programs and institutions in parallel to CORIGAP, which resulted in the contamination of the initial grouping.[1] Some respondents in the control sites adopted at least one of the CORIGAP interventions, while others in the treatment sites did

[1] In Myanmar, MyRice, an ACIAR-funded project, has developed best practices for rice production and postharvest to improve the productivity of rice-rice and rice-pulse cropping systems. In Indonesia, Integrated Crop Management (PTT) and the Special Efforts Program (UPSUS) target to enhance rice productivity and achieve self-sufficiency. The efficient use of resources and increased

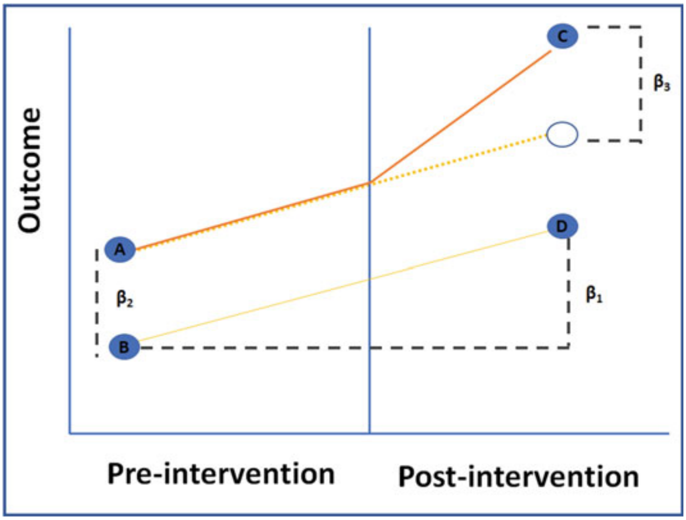

Fig. 7.4 Graphical illustration of the difference-in-differences method

Table 7.4 Calculation and interpretation of the regression coefficients

Coefficient	Calculation	Interpretation
β_0	B	Baseline average
β_1	D-B	Time trend in non-adopter group
β_2	A-B	Difference between two groups pre-intervention
β_3	(C-A)–(D-B)	Difference in changes over time

not adopt any of the interventions. Also, some respondents adopted one intervention, while other respondents adopted several. Table 7.5 shows the adoption rate of the interventions promoted by CORIGAP by season and by survey period. The adoption status of the respondents varied by season and by survey year. For instance, a respondent may adopt a specific technology during the wet season but not during the dry season and vice versa. In countries where three survey periods were implemented, a respondent may have adopted a specific technology during the midline period but not during the end-line period and vice versa.

Given the unbalanced number of adopters and non-adopters and the relatively small sample sizes for the midline and end-line periods for Thailand, Indonesia, and Myanmar, we decided to conduct an in-depth analysis of selected technologies in Vietnam only. Despite the contamination issues encountered during the surveys, the sample sizes for Vietnam in the baseline and midline periods have a more balanced

environmental quality are ways to accomplish this. In Thailand, the BMPs on has was promoted by the Thai Rice Department to increase farmers' income by reducing costs and ensuring yield is maintained or improved.

Table 7.5 Adoption rate (%) of CORIGAP interventions by country

Interventions	Midline		End-line	
	Wet season (%)	Dry season (%)	Wet season (%)	Dry season (%)
Vietnam				
	($n = 122$)	($n = 120$)	($n = 140$)	($n = 143$)
Improved Rice Varieties	67	63	32	29
AWD	75	79	67	51
Drum Seeder	20	17	1	0
Mechanical Transplanter	3	3	0	0
Ecologically-based rodent management	12	8	1	0
Laser Land Leveler	6	7	1	1
Combine harvester	98	100	89	73
Thailand				
			($n = 65$)	($n = 44$)
Improved Rice Varieties			15	16
Drum Seeder			18	18
Mechanical Transplanter			12	20
Solar bubble dryer			2	2
IRRI Superbag			2	2
Flatbed Dryer			2	2
Ecologically-based rodent management			2	2
Laser Land Leveler			2	2
Combine Harvester			29	23
Stripper Harvester			2	2
AWD			2	7
Indonesia				
	($n = 156$)	($n = 76$)	($n = 171$)	($n = 50$)
Improved Rice Varieties	83	92	91	90
Solar Bubble Dryer	30	37	27	36
Mechanical Transplanter	20	14	3	2
Combine Harvester	23	25	6	4
AWD	15	11	44	54
Drum Seeder	11	22	2	2
Ecologically-based rodent management	1	3	0	0
IRRI Superbag	8	17	1	0

(continued)

Table 7.5 (continued)

Interventions	Midline		End-line	
	Wet season (%)	Dry season (%)	Wet season (%)	Dry season (%)
Flatbed dryer	1	1	0	0
Stripper Harvester	5	4	0	0
Integrated Crop Management			3	4
Integrated Pest Management			13	8
Rice Crop Manager			1	0
Myanmar				
			($n = 148$)	($n = 142$)
Combine Harvester			32	37
Applying Balance Nutrients			16	15
Laser Land Leveler			8	10
Threshing (paddy immediately)			5	9
Drum Seeder			1	1
IRRI Superbag			1	0

distribution of adopters and non-adopters, particularly on improved rice varieties and AWD technology. Based on this, the DID method was applied to the improved rice varieties and the AWD technology using the panel data of baseline and midline surveys of Vietnam as a case study.

7.3.3.1 Case of Vietnam

We estimated the changes in key input factors and two outcome indicators (yield and income) between adopters and non-adopters by season. These input factors and outcome indicators are presented in Table 7.6.

Adoption rates of technologies are presented in Table 7.5 for all countries that benefited from the CORIGAP interventions. Vietnam showed high adoption rates for improved varieties and AWD technology, while Thailand had high adoption rates for improved varieties, drum seeders, mechanical transplanters, and combine harvesters. Indonesia had high adoption rates for improved varieties, combine harvesters, and mechanical transplanters, with a notable increase in AWD technology adoption during the midline period. The two most adopted technologies in Myanmar were combine harvesters and the application of balanced nutrients. Given the spill-over effects observed in all countries, we refrained from making comparisons on adoption rates between midline and end-line periods for Indonesia, Thailand, and Myanmar. However, we were able to examine changes between two survey periods for the top two technologies adopted in Vietnam. Tables 7.6–7.10 show the mean values of the

Table 7.6 List of indicators and their descriptions

Indicators	Description
1. Seed quantity (kg ha^{-1})	Quantity of seeds planted in kilogram per hectare
2. Frequency of irrigation (count)	No. of times irrigated the farm per hectare
3. Pesticide costs (US$ ha^{-1})	Total costs of pesticides applied in US$ per hectare
4. Nitrogen fertilizer (kg ha^{-1})	Quantity of nitrogen fertilizer applied in kilogram per hectare
5. Phosphorus fertilizer (kg ha^{-1})	Quantity of phosphorus fertilizer applied in kilogram per hectare
6. Potassium fertilizer (kg ha^{-1})	Quantity of potassium fertilizer applied in kilogram per hectare
7. Power and labor cost (US$ ha^{-1})	Total costs of machine and animal rental, fuel and labor costs in US$ per hectare
8. Yield (kg ha^{-1})	Total production over area planted in kilogram per hectare
9. Net income (US$ ha^{-1})	Total gross income minus the total production cost in US$ per hectare

key indicators by survey period and by adoption status of improved rice varieties and AWD during wet and dry seasons in Vietnam. The last column of each table contains the calculated values of the DID regression. Table 7.7 shows that there are significant differences in the power and labor cost (negative), yield (positive), and net income (positive) over the two survey periods between adopters and non-adopters of improved rice varieties. The negative value of the DID for the power and labor costs means that the adopters of improved rice varieties have fewer costs of power and labor over time compared to non-adopters. The positive DID results of yield and net income means that the adoption of improved rice varieties has a yield advantage of about 0.82 t ha^{-1} and a net income advantage of about US$327 over the non-adopters during the wet season. Results also show that there is no significant difference in the changes in seed rate, irrigation frequency, pesticide cost, and fertilizer quantity over time on whether they adopted or not adopted the improved rice varieties.

For the dry season, the change in the cost of pesticides applied over the two survey periods is significantly lower for the adopters of the improved rice varieties by about US$23 compared to the non-adopters (Table 7.8). For other indicators, the changes over time between adopters and non-adopters are not statistically significant.

Tables 7.9 and 7.10 show that the adopters of AWD have no significant difference in the DID values for all indicators for both the wet and dry seasons. In theory, it was expected that the farmers who adopted the AWD would use less water for irrigation compared to the non-adopters. However, the total amount of water used for irrigation during the whole cropping season was not monitored. As a proxy variable, we used the number of times a farmer irrigated the field during the wet and dry seasons. Results show that there is no significant difference in the frequency of irrigation between adopters and non-adopters of AWD. This could mean that farmers still continue to follow their normal frequency of irrigation, but the amount of water

Table 7.7 Mean values of the key indicators by survey period and by adoption status of the respondents on improved rice varieties and their difference-in-differences, wet season, 2018

Indicators	Baseline		Midline		DID
	Adopter ($n = 82$)	Non-adopter ($n = 40$)	Adopter ($n = 82$)	Non-adopter ($n = 40$)	
Seed quantity (kg ha^{-1})	106	95	165	171	–18
Frequency of irrigation (count)	6	6	6	6	0
Pesticide cost (US\$[a] ha^{-1})	119	120	133	133	0
Fertilizer quantity					
N (kg ha^{-1})	98	106	88	83	13
P (kg ha^{-1})	27	27	25	24	1
K (kg ha^{-1})	39	47	42	43	7
Power and labor cost (US\$[a] ha^{-1})	250	233	182	189	−23 *
Yield (kg ha^{-1})	8,761	9,367	7,387	7,173	821 **
Net income (US\$[a] ha^{-1})	1,647	1,953	949	928	327 **

[a]Values are in 2021 US$
*Significant at 10%, ** significant at 5%, *** significant at 1%
DID—Difference-in-differences

Table 7.8 Mean values of the key indicators by survey period and by adoption status of the respondents on improved rice varieties and their difference-in-differences, dry season, 2018

Indicators	Baseline		Midline		DID
	Adopter ($n = 76$)	Non-adopter ($n = 44$)	Adopter ($n = 76$)	Non-adopter ($n = 44$)	
Seed quantity (kg ha^{-1})	102	113	171	177	5
Frequency of irrigation (count)	6	6	6	6	0
Pesticide cost (US\$[a] ha^{-1})	109	100	115	130	−24 *
Fertilizer quantity					
N (kg ha^{-1})	98	103	84	84	5
P (kg ha^{-1})	26	28	23	25	−1
K (kg ha^{-1})	39	44	41	43	2
Power and labor cost (US\$[a] ha^{-1})	227	236	174	206	−23
Yield (kg ha^{-1})	5,814	6,082	6,020	5,906	383
Net income (US\$[a] ha^{-1})	827	984	577	557	177

[a]Values are in 2021 US$
*Significant at 10%, ** significant at 5%, *** significant at 1%
DID—Difference-in-differences

Table 7.9 Mean values of the key indicators by survey period and by adoption status of the respondents on alternate wetting and drying (AWD) and their difference-in-differences, wet season, 2018

Indicators	Baseline		Midline		DID
	Adopter ($n = 92$)	Non-adopter ($n = 30$)	Adopter ($n = 92$)	Non-adopter ($n = 30$)	
Seed quantity (kg ha^{-1})	99	111	163	177	−1
Frequency of irrigation (count)	6	6	6	6	0
Pesticide cost (US$[a] ha^{-1})	120	116	133	133	−4
Fertilizer quantity					
N (kg ha^{-1})	100	102	90	77	16
P (kg ha^{-1})	27	27	25	23	3
K (kg ha^{-1})	41	44	44	36	10
Power and labor cost (US$[a] ha^{-1})	243	246	179	193	−11
Yield (kg ha^{-1})	8,910	9,111	7,351	7,211	341
Net income (US$[a] ha^{-1})	1,695	1,909	952	911	256

[a]Values are in 2021 US$
*Significant at 10%, ** significant at 5%, *** significant at 1%
DID—Difference-in-differences

used by AWD adopters might be lower compared to the non-adopters. It has been shown that farmers in the Mekong Delta reported having reduced their water use. However, when specifically asked if they applied AWD as presented in the AWD manual, farmers were struggling to apply this technology correctly (Connor et al. 2021a). Furthermore, the geographical location of the fields and access to water were the main barriers to apply AWD in the recommended way (Tuan et al. 2022). The obtained results during the household survey may represent farmers' willingness to adopt AWD but do not represent the correct application thereof and, therefore, the expected reductions could not be observed.

7.3.4 Conclusions

This study focuses on three survey periods and examines the changes in farm management practices and resulting outcomes from the CORIGAP interventions using data collected in four countries, Vietnam, Thailand, Myanmar, and Indonesia. Some technologies stood out with high adoption rates during the midline and end-line periods, for example, the improved varieties, AWD technology, mechanical transplanter, and combine harvester. Many of these technologies have also spilt over to the non-intervention sites, which indicates the potential scalability of the promoted technologies. Given the unforeseen changes in the survey design, the econometric analysis to examine the contribution of CORIGAP intervention on production inputs,

Table 7.10 Mean values of the key indicators by survey period and by adoption status of the respondents on alternate wetting and drying (AWD) and their difference-in-differences, dry season, 2018

Indicators	Baseline		Midline		DID
	Adopter ($n = 95$)	Non-adopter ($n = 25$)	Adopter ($n = 95$)	Non-adopter ($n = 25$)	
Seed quantity (kg ha^{-1})	101	124	172	177	19
Frequency of irrigation (count)	6	6	6	6	0
Pesticide cost (US$[a] ha^{-1})	110	91	121	119	−16
Fertilizer quantity					
N (kg ha^{-1})	101	95	83	85	−8
P (kg ha^{-1})	27	28	23	25	0
K (kg ha^{-1})	41	42	41	44	−1
Power and labor cost (US$[a] ha^{-1})	228	237	185	193	1
Yield (kg ha^{-1})	5,877	6,046	6,028	5,790	407
Net income (US$[a] ha^{-1})	874	923	587	506	129

[a]Values are in 2021 US$
*Significant at 10%, ** significant at 5%, *** significant at 1%
DID—Difference-in-differences

yield and income, was only implemented for Vietnam. The results showed that the adoption of improved rice varieties has a yield advantage of about 0.82 t ha^{-1} and a net income advantage of about US$327 over the non-adopters based on the level of changes from baseline to midline survey during the wet season. An analysis of the Myanmar data published by Wehmeyer et al. (2022) found that all farmers experience substantial positive changes. These changes were in line with national development efforts. In general, differences between adopters and non-adopters were not significant. There were, however, differences between the rice-rice and rice-pulse cropping patterns, indicating that rice-pulse farmers had higher yields than rice-rice farmers even though rice-rice farmers had larger cultivation areas received higher agricultural credits, and had superior income levels. The study further found that education was an important predictor of yield, indicating its importance for accelerating agricultural development in Myanmar. Therefore, one recommendation for Myanmar is to improve extension services and knowledge transfer to expand the dissemination of sustainable BMPs and make farmers more resilient against the negative impacts of climate change (Wehmeyer et al. 2022).

There were several challenges and limitations related to the survey design, data analysis, and econometric method. Intervention programs that promote a bundle of technologies often pose the challenge of defining adoption for econometric analysis. A respondent can adopt multiple and different combinations of interventions, which makes it difficult to determine the contribution of each intervention to the key indicators. One possible solution is to segregate the analysis into different bundles of interventions; however, it requires large sample sizes. Before the midline and endline surveys, other organizations and institutions also promoted some interventions similar to the ones disseminated by the CORIGAP program, which resulted in the contamination of the initial grouping in our survey design. Since development does not happen in isolation, outcome and impact assessments need to take these facts into account and opt for different methodologies, such as contribution analysis (Apgar et al. 2020; Mayne 2012) or process tracing (Ton 2012) which have been shown to be effective methods to account for project contributions on development issues. Nevertheless, based on the analysis, the study indicated that the CORIGAP interventions contributed to the observed changes in farm management practices and related outcomes in the focus countries.

7.4 Perception of Economic and Social Changes

A lot of studies exist that investigate the uptake of agricultural technologies and practices covering a plethora of crops, ecosystems, and sociocultural contexts. Such studies often distinguish between external and internal factors that can influence the adoption of new technologies and practices. External factors generally concern the biotic environment in which crops are grown, such as field conditions (Connor et al. 2021a), soil composition (Dai et al. 2015), or irrigation (Connor et al. 2021a). Furthermore, farmers' personalities and knowledge have been classified as internal factors affecting technology adoption (Bopp et al. 2019; Connor et al. 2021a; Dang et al. 2014).

As described in Sect. 2.5, farmers in Guangdong province, China, were introduced to the 3CT aiming to reduce the use of inorganic fertilizer while decreasing the number of unproductive tillers and controlling pests and diseases (Wehmeyer et al. 2020). For this cross-sectional study, 142 farmers from six villages were interviewed to evaluate perceived changes in their farming and livelihood. We found that all farmers in the sample adopted 3CT. Furthermore, the results showed that the farmers were highly satisfied with 3CT and perceived positive livelihood changes and increased agronomic performance while reducing fertilizer use. Farmers who had adopted 3CT for the longest perceived significantly higher levels of change, more benefits, and improved agricultural efficiency (Wehmeyer et al. 2020). These results show that 3CT has great potential to be implemented in other regions of China (Wehmeyer et al. 2020).

In Indonesia, we investigated 153 farmers in three sub-districts of Yogyakarta. Especially in Indonesia, an archipelago in the Pacific Ocean, the adoption of sustainable technologies is crucial for climate change adaptation and mitigation. We investigated the adoption of sustainable rice farming technologies and practices with a special focus on additional revenue allocation and perception of social, economic, and environmental change (Connor et al. 2021b). Farmers adopted two technologies or practices, which, as presented above, were high-yielding rice varieties. Farmers increased their revenue from US$105 to US$122 per hectare per season. The main barriers to adoption included time constraints, unsuitability for field conditions, and incompatibility with cropping systems. This study also provided insights into where farmers will invest the additional income. We found that farmers invested the extra income in their farming businesses and also improved their diets. Farmers reported having experienced several changes due to the adoption of technologies and practices that were introduced through the CORIGAP project. These changes were observed in social and human capital as well as perceived poverty reduction in the area (Connor et al. 2021b).

In Vietnam, we placed a special focus on the adoption of the 1M5R recommendations (Chap. 4). 1M5R is a complex technology package that has been rolled out widely across the Mekong River Delta. Here, we were specifically interested in also investigating the adoption constraints. We investigated a total of 465 farmers in An Giang and Can Tho Province (Connor et al. 2021a). We found that farmers generally followed the requirements of pesticide reduction, postharvest loss reduction, and the use of certified seeds. However, farmers had problems reducing their fertilizer use, water use, and seed rate (Connor et al. 2021a). Reasons farmers mentioned included that practices were difficult to follow and to apply in the correct and prescribed way. A regression analysis results in several factors predicting the adoption of the whole package of the 1M5R requirements. However, the adoption of the individual requirements was mainly driven by the ease of implementation and non-rice income, especially for practices with lower adoption rates (Connor et al. 2021a).

The adoption of best management practices was investigated with 129 farmers in two regions in Myanmar, the Ayeyarwady Delta and the Bago region. Reasons for adoption included higher yields, reduced costs, and labor savings. Reasons for non-adoption included unsuitable or expensive practices (Connor et al. 2021c). There was an estimated increase in income (>0) of 113 US$ ha^{-1} (SD = 90.64 US$ ha^{-1}), due to an increase in yield and reduced costs. Farmers were further asked what they did with their additional income. A considerable number of farmers stated that they use that income for religious and social activities, food, health care, and education. Some farmers were able to expand their farm business, and by adopting the new technologies and practices, these farmers produced rice more sustainably (Connor et al. 2021c).

7.5 Meta-Analysis of CORIGAP's Knowledge Management System and Research Outputs

This sub-chapter describes the project's knowledge management system, from knowledge product development to outreach mechanisms. Specifically, for scientific and adaptive research publications, a bibliometric mapping of terms and citations describes the level of alignment with the existing research thrusts. Lastly, this section will also provide how far out the products and mechanisms reached its stakeholders, the general public, and evaluates their contribution to the body of knowledge.

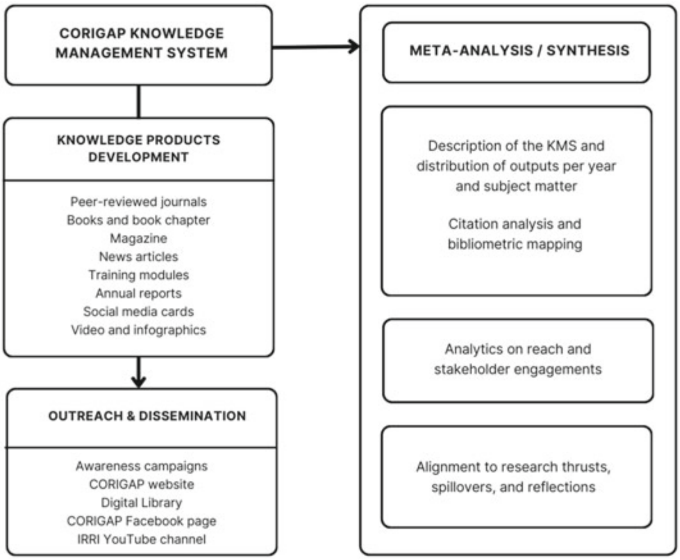

Fig. 7.5 Framework for synthesizing CORIGAP knowledge management system

Figure 7.5 illustrates the thought process of synthesizing CORIGAP's knowledge management system.

7.5.1 CORIGAP Knowledge Management System

A suite of knowledge products was developed over the years to scale the project outputs further and transfer the learnings to stakeholders and the general public. Outreach and dissemination strategies for reaching different audiences were segmented into various tools and media. CORIGAP has invested in digital repositories and online information campaigns to expand the outreach of every knowledge product developed.

7.5.1.1 Knowledge Products Developed Between 2013 and 2023

The inventory of CORIGAP knowledge products in ten years is listed in Table 7.9. The intended audiences of the materials encompass stakeholders from within and outside the organization, from project researchers and scientists to national partners in the country sites. It also went as far out as the extension workers and the general public. CORIGAP has published a total of 104 peer-reviewed articles in scientific journals and eight book chapters. A bibliometric mapping of these materials is provided in the next section to provide in-depth insight into the metadata.

About 144 information cards published on CORIGAP's online platforms have translated scientific outputs into general knowledge for the public. These information cards, usually pictured in high-resolution images and captions, are a valuable tool to simplify science communication for non-scientific audiences. In Phase III, information cards were frequently used to launch themed awareness campaigns and to feature old and new publications.

Additionally, 58 news articles were traced from local news outlets in Southeast Asia featuring the works and outreach activities of CORIGAP in the region. The IRRI editorial unit published news features about the project to further disseminate the outputs to its stakeholders globally. CORIGAP was also featured in 11 issues of IRRI's Rice Today online magazines.

In 2022, selected scientific publications and project milestones were rehashed into five outcome story videos capturing the local partners in Vietnam, Thailand, Myanmar, Indonesia, and Sri Lanka. Video products cover various topics, from stories of success in the field to informative videos on selected mechanization and postharvest technologies translated into local languages and English. Instructional videos on sustainable pest management are also available. Currently, there are 53 video materials accessible on YouTube and the CORIGAP digital library (https://corigap.irri.org/digital-library/publications).

The CORIGAP team has made available PDF copies of training modules on technology use and training event facilitation which can also be found in the CORIGAP repository. In 2022, the team published a 35-page toolkit for facilitating Learning Alliance (Chap. 6) and other multi-stakeholder platforms under the Creative Commons license. Learning Alliance consists of networks focused on learning the changes and involved in the complex process of capturing the learnings. The rationale is that technological change in the food system is a dynamic process that, in return, requires change across its networks of stakeholders. As behaviors change, so are the tools and approaches (Flor et al. 2022). The toolkit was published to provide facilitators and members of a multi-stakeholder platform the guidance and techniques to support learnings within their network (Table 7.11).

7.5.2 Outreach and Dissemination Strategies for Knowledge Products

7.5.2.1 Repository Building Through a Digital Library

The CORIGAP digital library is an online repository of published and verified materials created during the project's lifespan. It was developed in 2021 to store all CORIGAP knowledge products under the IRRI domain. It now holds peer-reviewed journal articles, books, book chapters, magazines, news articles and features, proceedings, training modules, and video resources. In 2022, materials

Table 7.11 Inventory of CORIGAP knowledge resources between 2013 and 2022

Knowledge Product	Intended audience	Count produced (2013–2022)
Peer-reviewed journal	Scientists, researchers, academe, extension workers	104
Social media info cards	Local partners, general public	144
News article	Scientists, researchers, extension workers, general public	58
Videos	Local partners, extension workers, general public	49
Reports	Donors, scientists, researchers	12
Magazine	General public	11
Book and book chapters	Scientists, researchers, academe, extension workers, local partners	8
Training module	Local partners, extension workers, researchers	3
Total products		**389**

from the Irrigated Rice Research Consortium (IRRC) were included in the repository. For ease of access and retrieval, search and filter functions are based on the publication year, country of focus, type of material, CORIGAP author, and title. To date, more than 300 materials are stored in the digital library.

7.5.2.2 Information and Awareness Campaigns

Despite the mounting number of knowledge resources produced over the years, there remained a gap for the general public to access information and materials. Themed information and awareness campaigns on social media (i.e., Facebook, Twitter, LinkedIn) were conceptualized to raise CORIGAP's visibility and amplify its collaboration with its national partners. One strategy that the CORIGAP team applied to cope with the limited attention span of social media users was the use of creative information cards with digested science information and visual cues. The online campaigns also served as a channel to direct interested users to the website and digital library, where downloadable publications and products are available for free.

Some of the notable online campaigns of CORIGAP include the following:

1. "Frogs of IRRI," an information campaign on the functional roles of frogs in the rice ecosystem
2. Launch and month-long promotional campaign for the CORIGAP Digital Library featuring selected works of CORIGAP scientists
3. International Women's Day featuring CORIGAP's women scientists and female NARES partners and their contributions to shaping CORIGAP's work in Southeast Asia

4. Promoting a partnership event with DLG (German Agricultural Society) and Agritechnica Asia in Bangkok, Thailand
5. Livestreaming of the CORIGAP Science and Lessons Learned Seminars in Can Tho, Vietnam
6. Pre-promotion campaign and snippets of the CORIGAP book and legacy site.

7.5.2.3 Website and Social Media Networks

Traditionally, project updates only happen internally and are arranged in physical venues. With social media and online browsers' rising popularity, stakeholders have become closer to accessing information with mobile devices, such as cell phones, laptops, and tablets. Syntheses from project activities and training events can be shared online as they happen. In this manner, there is the assurance that the intended audience receives relevant and up-to-date information. Using the CORIGAP online accounts (i.e., Facebook, YouTube, website), the team featured events on the field, country meetings, and training events. They were especially used to feature scientific findings, training modules, and science seminars' live streams that further enable stakeholder engagements. Google Analytics platform was used to track the online reach and engagement of social media campaigns.

Sponsoring online campaigns also expanded the reach and public engagement of the project. In a social media campaign between November and December 2021, an information card about the regional demand for packaged and labeled rice in Vietnam reached 295,683 users, of which 42,022 moved on to the CORIGAP page to access the related publication. Another material on factors leading to the adoption of CORIGAP technologies reached 483,819 users, of which 174,487 moved on to the CORIGAP digital library. Visitors came from CORIGAP countries, but outreach was global, including India, Bangladesh, Nepal, Ethiopia, Nigeria, and Pakistan (Google Analytics). In December 2022, an online campaign released a total of ten information cards and reached over 2.9 million users globally, and routed more than 132,000 unique accessions to the digital library. In 2022, the CORIGAP website's unique visits and traffic increased by 88%, and it now has 21,742 users.

7.5.2.4 Bibliometric Mapping of CORIGAP's Contribution to the Body of Knowledge

Bibliometric data were collected from the CORIGAP digital library and cross-referenced with the Web of Science bibliographic database. The final dataset contains the metadata of 104 CORIGAP peer-reviewed journal publications from 2013 to 2022. Search filters based on topic, funding agency, publishing years, and authors were used to locating all the CORIGAP journal publications.

Table 7.12 rounds up CORIGAP's share in SDC-funded publications as sectors get more specific. CORIGAP has a share of 36.2% of the 287 food-sector publications funded by SDC between 2013 and 2022 globally, 52.5% for agriculture ($n = 198$), and 89.7% for rice ($n = 116$) sectors.

Table 7.13 lists the distribution of CORIGAP peer-reviewed publications per research area. More than half (52%) of the publications are in the agriculture research area, while 36% are in engineering, food, and science technology. About a third (34%) of the publications are under environmental sciences, particularly ecology, water resources, and biodiversity conservation. Categorically, 22% of the research focuses on the biological sciences, mainly in entomology, zoology, plant sciences, and toxicology. Eight publications were produced for economics and development studies toward the later phase of the project.

The publications have combined citations of 1,915, garnering an average of 18.41 citations per material and an H-index of 23.0. An H-index above 20 is within the good range index of productivity (Hirsch 2005). Figure 7.6 illustrates the citation map of CORIGAP peer-reviewed publications. Each circle represents a journal, and the size of the circle depicts the number of citations in that journal. The journal citation clusters concentrated on field crops research, agriculture ecosystems, and social sciences. Table 7.14 lists the five CORIGAP publications with the most citations,

Table 7.12 Publications funded by the Swiss Agency for Development and Cooperation (SDC) between 2013 and 2022

Sector	Count	% share of CORIGAP ($n = 104$)
Global	1,797	5.8
Food	287	36.2
Agriculture	198	52.5
Rice	116	89.7

Source Web of science

Table 7.13 Distribution of CORIGAP peer-reviewed publications per research area

Research area	Record count	% of 104
Agriculture	54	52
Engineering, Food, and Science Technology	37	36
Environmental Sciences (34%)		
Environmental Ecology	26	25
Water resources	6	6
Biodiversity Conservation	3	3
Biological Sciences (22%)		
Entomology	10	10
Zoology	6	6
Plant Sciences	5	5
Toxicology	2	2
Economics and Development Studies	8	8

Source Web of science

Fig. 7.6 Citation network map of CORIGAP peer-reviewed publications

topped by Lampayan et al. (2015) on the topic of adoption and economics of alternate wetting and drying for irrigated lowland rice and followed by Akter et al. (2017) about Women's empowerment and gender equity in agriculture: A different perspective in Southeast Asia.

For the co-occurrence network of CORIGAP publications, terms with a minimum of ten co-occurrences were preserved and computed for relevance rates and link strength. This way, only the terms with the most robust relevance and linkages were mapped.

Figure 7.7 illustrates the network of terms and co-occurrence relations using the text-mining functionality of the VOSviewer platform (https://www.vosviewer.com). Each circle represents a term, and the circle's size represents the number of publications regarding that term. A total of 3,672 terms were processed using a network language processing technique where a linguistic filter was applied to tag the parts of speech. The words that were not relevant were excluded from the processing. Clusters are formed to represent the concentration of terms according to topics. Three clusters (blue, red, and green) were identified in the network map using the dataset's keywords, titles, and abstracts.

Terms of topics on "productivity," "efficiency," "performance," "difference," and "comparison" frequently occurred in the blue cluster, showing that a proportion of the CORIGAP publications touch on change indicators and quantifiable measures. The subject matters of "water productivity" and "grain yield" also co-occurred with the abovementioned measures. The red cluster illustrates the co-occurrences of the terms "farmers," "rice field," "smallholder," "rodent pest," "species," and "weed," indicating that a proportion of the publications touch on grassroots studies and challenges on the field level. It also linked the "Philippines" and "Cambodia" countries with serious pest concerns. In the green cluster, co-occurrence was observed among the terms "climate change," "greenhouse gas emission," "sustainability," and "energy efficiency" and linked heavily to "Vietnam" and "Thailand." Lastly, terms in the green cluster touch on environmental indicators, such as greenhouse gas emission, energy efficiency, sustainability, and climate change. The terms also have associations with the words "data," "evidence," and "gap."

Some terms transect multiple clusters. The terms located in the central region of the network map similarly have the most linkages to other words and clusters. Figure 7.8 shows the most cross-cutting terms, namely "data," "efficiency," and "problem," respectively. The term "data" has strong linkages in the environmental indicators in the green cluster but spanned as far out as the red and blue clusters

Table 7.14 Five CORIGAP publications with the most citations

Title	Author	Source	Publication year	Total citation
Adoption and economics of alternate wetting and drying water management for irrigated lowland rice	Lampayan, Rubenito M.; Rejesus, Roderick M.; Singleton, Grant R.; Bouman, Bas A. M	Field Crops Research	2015	245
Women's empowerment and gender equity in agriculture: A different perspective from Southeast Asia	Akter, Sonia; Rutsaert, Pieter; Luis, Joyce; Htwe, Nyo Me; San, Su Su; Raharjo, Budi; Pustika, Arlyna	Food Policy	2017	105
Grain yield, water productivity, and nitrogen use efficiency of rice under different water management and fertilizer-N inputs in South China	Pan, Junfeng; Liu, Yanzhuo; Zhong, Xuhua; Lampayan, Rubenito M.; Singleton, Grant R.; Huang, Nongrong; Liang, Kaiming; Peng, Bilin; Tian, Ka	Agricultural Water Management	2017	90
Grain yield, water productivity, and CH4 emission of irrigated rice in response to water management in South China	Liang, Kaiming; Zhong, Xuhua; Huang, Nongrong; Lampayan, Rubenito M.; Pan, Junfeng; Tian, Ka; Liu, Yanzhuo	Agricultural Water Management	2016	75
Yield gaps in rice-based farming systems: Insights from local studies and prospects for future analysis	Stuart, Alexander M.; Pame, Anny Ruth P.; Silva, Joao Vasco; Dikitanan, Rowell C.; Rutsaert, Pieter; Malabayabas, Arelene Julia B.; Lampayan, Rubenito M.; Radanielson, Ando M.; Singleton, Grant R	Field Crops Research	2016	72

Source Web of science

having co-occurrences mostly on quantitative terms (efficiency, comparison, difference, experiment) and descriptive terms in the field (rodent, rice field, species, pest, context, contrast).

Similarly, the term "efficiency" in the blue cluster traced strong internal links to "water productivity" and "grain yield" but are as associated with "yield gap," "sustainability," and "data" in the green cluster as well as "problem," and "rice field" in the red cluster. The term "problem" has demonstrated strong internal relevance to the terms "weed," "pest," "rodent," and "farmers" Interestingly, the term also stretches

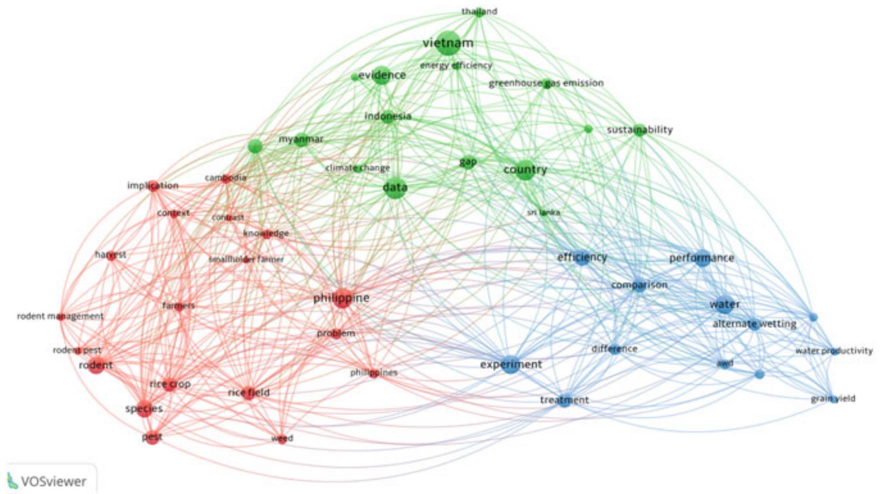

Fig. 7.7 Network of terms and co-occurrence relations of CORIGAP peer-reviewed publications

as far out as “Indonesia” and “Sri Lanka” in the green cluster and “experiment,” and “water management” in the blue cluster.

7.5.2.5 Alignment with IRRI’s Research Thrusts, Spillovers, and Reflections

CORIGAP’s contribution to the body of knowledge is substantially reflected in its scientific publications. CORIGAP’s adaptive and scientific research, in terms of subject matter, is data-driven and aligned with generating evidence to improve rice productivity and is well integrated into sustainable models context-specific in Southeast Asia. CORIGAP’s scholarly impact is notably well based on the bibliometric indexing of the Web of Science.

While more than half of the scientific outputs categorically contribute to agronomic research, almost half transect multiple disciplines such as engineering and food science technology, environmental and biological sciences, and development studies. Multi- and transdisciplinarity are vital toward a holistic approach that involves a range of stakeholders, particularly those from the grassroots and extension sectors.

Another way to adapt to science communication’s changing landscape is to optimize the use of enabling technologies and social media networks. Readers have shifted to electronic devices and internet connectivity in the past decade. This has been the impetus to create a basic digital library to access resources with download and hyperlink functions. Many of the population are subscribed to at least one social media network to access information from local and international sources. Inevitably, due to the massive amount of online data, social media consumption created an audience that demands easily digestible information with strong visual

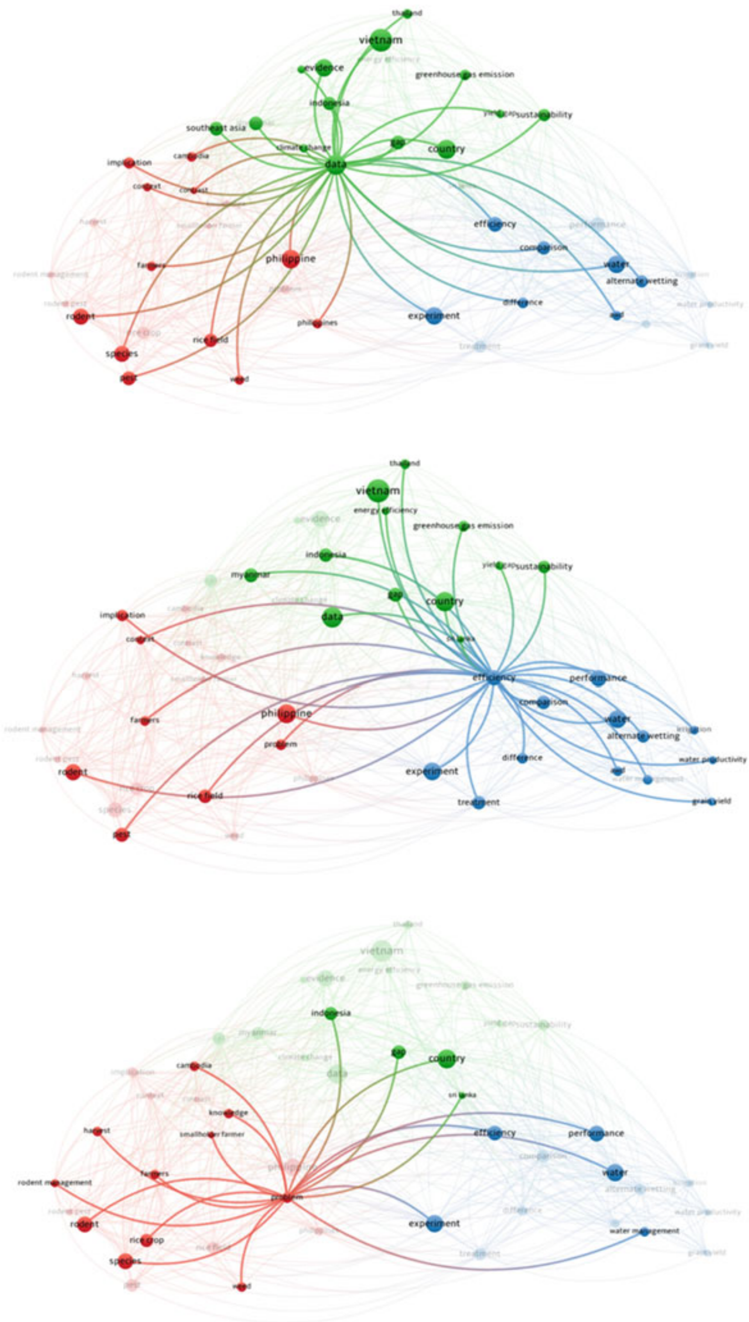

Fig. 7.8 Sub-network of cross-cutting terms "data," "efficiency," and "problem"

cues that can be conveyed quickly. In the case of CORIGAP, a social media post gains more public engagement when the scientific knowledge is in layperson's terms and with associated visual material.

The functionalities of social media expanded the audience base of CORIGAP and transformed the science jargon into general knowledge. It not only provides scientific information but is also integrated into other products making CORIGAP more accessible. Each post on social media included a call-to-action for the viewers linking them to the repositories (i.e., website, digital library). Information and awareness campaigns through social media networks are another form of reaching the general public more effectively. An effective knowledge management system does not only revolve around knowledge generation and collation to a central repository. It is imperative to translate each knowledge product in a manner that can be understood and accessible by any member of the public in any medium available to them.

One of the positive spillovers of communicating through social media is the expansion of reach to demographics that were not even part of the initial targeting. Integrating into the transforming information system creates platforms that enhance the capacity to transfer learning and engage stakeholders down to the grassroots level, including the unintended audiences. Online presence of CORIGAP spread as far out as South Asia and Africa, evident from the number of inquiries and web analytics coming from these regions. Such action could branch to different opportunities, including scaling out to other areas and further uptake of the best practices.

In conclusion, investing in a forward-looking knowledge management system is essential, especially for repository-building and knowledge-sharing platforms. CORIGAP Phase III captures the impact and mutual benefits realized during Phases I and II, so stakeholders and the general public can access information beyond project closure. The tools developed for outreach and dissemination are knowledge repositories that will continue to exist for as long as they are relevant.

7.6 Anecdotal Evidence of CORIGAP's Influence on Policy

One of the main reasons for the success in the out-scaling of CORIGAP research outputs was the inclusion thereof in national programs. This required influencing policy decisions so that the CORIGAP technologies and management practices would be incorporated into national programs. There were several pathways that the project pursued.

1. **Collaboration with national scientists** and research institutions as part of the CORIGAP activities. Every year throughout the project cycle, the national partners developed work plans based on the activities and findings of the previous year in the annual review and planning meetings. These were then implemented, and awareness and results were disseminated to the national policymakers through their reporting channels.

2. **Visits to policymakers during travel of CORIGAP scientists** in the partner countries. Both IRRC and CORIGAP scientists influenced policy informally by making sure that they visited national policymakers during their travel and updated them on project progress, and lobbied for linkages to national programs.
3. Senior research managers connected to policy as members of the **CORIGAP advisory committee (AC)**. The AC met annually during or after the annual review and planning meeting. AC's direct involvement in the project review and planning ensured that the national policy level was informed. They also provided valuable input about national policy to ensure that CORIGAP was in line with national priorities.
4. Participation of policy influencers in **Participatory Impact Pathway Analyses (PIPA)** and **Learning Alliances (LA)**. After the introduction of the PIPA and LA approaches to IRRI by the CORIGAP Postharvest Team, many postharvest activities started with a PIPA and led to the creation of a LA. The PIPAs usually had some policymaker or policy influencers as participants. They not only learned about what the project aimed to achieve but also actively participated in the design of activities and then often supported activities, e.g., in An Giang, where CORIGAP postharvest activities were funded by 1/3 by CORIGAP, 1/3 by the private sector, and 1/3 by the national extension system, after the PIPA.
5. **Seminars for policymakers** were not explicitly planned except for the last phase for 2021, during which they could not be implemented due to the COVID-19 lockdowns and travel restrictions. However, the postharvest team implemented one seminar on hermetic storage in Indonesia (2007) and one in Vietnam, each on laser leveling (2013) and hermetic storage (2017), targeting policymakers exclusively. During field days, demonstrations on laser leveling or during the AGRITECHNICA ASIA Live events in Myanmar (2019) and Vietnam (2022), many policymakers participated and learned about CORIGAP outputs and outcomes.
6. The **Council for Partnership on Rice Research in Asia (CORRA)** is composed of the leaders of the national agricultural research and extension systems (NARES) of 16 rice-growing countries in Asia and IRRI. Before COVID-19, CORRA members met annually. CORIGAP scientists were often invited to present their research, which in turn resulted in requests from CORIGAP members to start activities in their countries.
7. **Conferences and Seminars**. Scientific conferences and seminars are sometimes attended by policymakers. This was, in particular, the case for the International Rice Congress (IRC), which was organized by IRRI every four years in a different country (New Delhi (2006), Hanoi (2010), Bangkok (2014), and Singapore (2018). Each IRC drew a lot of attention, also from policymakers. During the IRC in Vietnam and in Thailand, ministerial round tables were held as side events of the scientific congress, which exposed the ministers to IRRI's outputs, including CORIGAPs.
8. Through **CORIGAP publications** like RIPPLE and web-based information channels and also non-scientific publications that were read by policy influencers/makers like Rural 21.

Table 7.15 Government decrees/resolutions in Vietnam that were directly or indirectly influenced by the project

Degree/ resolution	Title	Issuer, date of issue
63/ 2010-QĐ-TTg	On "Policy of supports to reduce post-harvest losses of agricultural products and aqua-cultural products."	Vietnamese Prime Minister, 15th Oct. 2010
109/2010/ NĐ-CP	"Exportation of Vietnamese rice" or called "Obligatory conditions for food companies/traders exporting of rice."	Vietnamese Prime Minister, 04th Nov. 2010
560/ QĐ-BNN-CB	Temporary regulations of technical requirements for paddy storage and rice milling plants servicing for rice export	Minister of Agriculture and Rural Development (MARD), 24th Mar. 2011
65/ 2011-QĐ-TTg	An amendment and addition to some articles of Decision No. 63/2010-QĐ-TTg on "Policy of supports to reduce post-harvest losses of agricultural products and aqua-cultural products" issued on 15th Oct. 2010'	Vietnamese Prime Minister, 02nd Dec. 2011

9. Inclusion of CORIGAP outputs in **national rice strategies**. In Myanmar, for example, CORIGAP scientists were working very closely with their partners, who were also contributing to the national rice strategy. In other countries, the impact pathway was less direct, but usually, the national scientists were asked for inputs to rice strategies, and thus CORIGAP outputs were also included.
10. A major impact on policy, although not measured and documented scientifically, came through the participation of CORIGAP scientists with their COPRIGAP products in **national programs.** Examples from Vietnam are the World Bank-funded Agricultural Competitiveness Project (ACP) and Vietnam Agricultural Transformation (VNSat), and the ADB-funded Strategic Research for Sustainable Food and Nutrition Security in Asia project. The latter was an IRRI-coordinated project with activities on postharvest in Vietnam, Cambodia, and the Philippines. It used CORIGAP outputs as interventions.

Table 7.15 provided an overview of government decrees/resolutions in Vietnam that were directly or indirectly influenced by the project. It needs to be noted that the influence on policies was not an explicit outcome of the project and was, therefore, not systematically monitored. However, in future projects, this should be included in the Theory of Change and monitored with the respective indicators.

7.6.1 Lessons Learned

Engaging with the policy level, initially informally during visits of CORIGAP scientists to policymakers, led to CORIGAP outputs being incorporated into national programs. This led to successful scaling out through national programs. In fact, after Phase II, CORIGAP exceeded the target of reaching 500,000 households and had reached more than 883,000[2] by March 2023. Having high-level national research managers with good input to national policy formulation also helped in that process. Targeted policy dialogue activities through CORIGAP were only conducted in limited numbers. Evidence of the impact of the project on the policy level is, therefore, anecdotal. In the future, similar projects that target scaling, activities, and resources for policy discourse should be included at the early stages of the project.

In the following, we propose some ways to have effective impacts on postharvest policies for the Vietnamese government:

- Provision of consultation directly to policymakers of MARD or indirectly to policymakers of the government;
- Written reports related to postharvest of rice directly to MARD;
- Awareness of postharvest losses, causes, and solutions to the public, particularly stakeholders of the rice supply chains and the local authorities, and the government via interviews by media means, such as central or local televisions, newspapers;.
- Lectures on postharvest of rice and training courses for provincial extension centers, rice farmers, rice cooperatives, food companies, etc.;
- Study tours showing good models of postharvest for all value chain stakeholders;
- Published papers/presentations at conferences/seminars/workshops organized by MARD, Ministry of Industry and Trade, Ministry of Science and Technology, other organizations under MARD, provincial authorities, various projects in the Mekong Delta, the South Western Steering Committee (belonging to the government), or the government.

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[2] 883,000 is the latest number computed. However, some data are still reviewed by the national partners to be included.

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