EARTH SECURITY GROUP

FINANCING SUSTAINABLE RICE FOR A SECURE FUTURE

INNOVATIVE FINANCE PARTNERSHIPS FOR CLIMATE MITIGATION AND ADAPTATION

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Earth Security Group (ESG) is a strategic intelligence agency that enables the public and private sectors to engage, align and work together for climate resilience and sustainable development.

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Sustainable Rice Platform

United Nations Capital Development Fund

World Business Council for Sustainable Development

EXECUTIVE SUMMARY

RICE: AN UNDER-APPRECIATED GLOBAL IMPACT FINANCE OPPORTUNITY

Key Point 1

Rice is the main staple food for 3.5 billion people, more than half of the world's population, and it is critically exposed to the effects of climate change and water scarcity.

Rice is grown by 150 million smallholder farmers who are mostly poor, in small plots of land of less than 1 hectare. It uses 40% of all irrigation water globally and is responsible for 10% of the world's methane emissions. Most of the world's rice is consumed close to where it is produced. Less than 10% is traded internationally, increasing the risks of dangerous price volatility brought about by climate shocks or export restrictions. A number of innovative production practices already exist that, if implemented at scale, could mitigate the sector's sustainability and resilience challenges while raising productivity. However, the high fragmentation of smallholder production needs creative approaches to deploy sustainable finance along the value chain. This report explains how global impact investors can help the transition to sustainable production.

Key Point 2

While China and India are the world's largest rice producers, the report focuses on Southeast Asia and West Africa — two regions with significant potential to increase production sustainably.

China and India are geographically large enough that they could relocate production in response to climate change. However, smaller countries in the tropical belt will have less room to adapt. Southeast Asia and West Africa are uniquely vulnerable to the combined impacts of climate change, water scarcity and food insecurity, making the need to scale sustainable rice production a pressing priority.

Key Point 3

The UN-facilitated Sustainable Rice Platform (SRP) Standard and Performance Indicators provide a robust basis for creating new mechanisms to finance sustainable rice value chains.

The report's innovative finance blueprints build on SRP's rice production standard and performance indicators as a framework to design new finance mechanisms. For example, SRP's indicators inform the design of instruments such as 'rice bonds', digital finance platforms to scale financing to smallholder farmers, and blended finance funds that deploy climate finance to achieve a transformation towards sustainable rice value chains.

Key Point 4

Innovative financing instruments can be used to mobilise private sector investments towards climate-smart rice production.

This will require public-private cooperation and new financial delivery mechanisms that leverage global climate finance. Companies in the rice value chain that are making sustainable production and farmer livelihoods a key part of their business models are well-positioned to attract new forms of sustainable finance. However, rice is not a well-known or well-understood impact finance opportunity for investors, and much remains to be done to ensure that international climate finance can be used to attract private sector investments into climate-smart agriculture.

EXECUTIVE SUMMARY

BLUEPRINTS TO BUILD INNOVATIVE FINANCE MECHANISMS FOR SUSTAINABLE RICE

The report's recommendations identify opportunities to adapt sustainable finance innovation to the rice sector's sustainable transition. These provide practical pathways for private sector investments to help achieve countries' commitments to climate mitigation and adaptation.

In developing these proposals, Earth Security has engaged over 60 stakeholders including banks, asset managers, impact investors, major rice traders and agribusiness companies, international organisations and civil society groups, in collaboration with its action partners, through workshops and interviews.

Blueprint 1

Create a digital finance platform for financing to reach smallholder farmers

This initiative addresses the absence of an integrated financial infrastructure to serve millions of rice smallholders who lack access to financial services. We recommend developing a digital finance platform that gives smallholders that are working towards compliance with the SRP Standard access to bundled financial services and market linkages to sustainable value chains. Such a platform would facilitate interoperability with existing data platforms led by agribusinesses, research and development agencies, and creating agreements with banks and other financial institutions. Such a platform could effectively help to create the financing architecture that is missing to support the more than 140 million smallholder rice farmers around the world.

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Blueprint 2

Issue a 'rice bond' to finance sustainable rice value chains

This concept addresses the need for upfront capital for companies, suppliers and farmers to switch to climate-smart production. A 'rice bond' would enable a global rice processor, trader, or retailer to provide farmers in their value chain with capital to transition to sustainable production: improve farming practices, increase yields and revenue, and become more resilient to climate risks. We recommend integrating the SRP Performance Indicators into the Climate Bonds Initiative (CBI)'s taxonomy for green bonds in agriculture, as a common basis on which a 'rice bond' can be designed, issued and reported on. Additionally, we explore other types of 'rice bonds' as an innovative form of finance that incentivises sustainable procurement. These include issuing a 'rice bond' to enable the World Food Programme (WFP) to drive the procurement of sustainable rice at scale.

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Blueprint 3

Leverage international climate finance to attract private sector investment for climate-smart rice production

This proposal addresses the opportunity for more climate finance to be directed towards resilient agriculture systems. Countries in Asia and Africa that are already receiving donor funds to develop climate-smart rice production, such as more efficient irrigation systems, can use these funds as a catalyst to attract private investment. Innovative models range from issuing a 'sovereign green bond' for agriculture investment, to blended finance vehicles that enable agri-businesses and local banks to increase the access to finance of smallholders. Landscape-based and carbon market-based solutions will play increasingly important roles. Using public finance strategically would enable the private sector to play a more prominent role in helping governments to achieve their climate-smart agriculture pledges, as reflected in their Nationally Determined Contributions (NDCs) and National Adaptation Plans (NAPs).

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1 INTRODUCTION
SEVEN FACTS THAT MAKE SUSTAINABLE RICE A CRITICAL IMPACT COMMODITY

SEVEN FACTS MAKING SUSTAINABLE RICE A CRITICAL IMPACT COMMODITY

Rice is the third-biggest crop globally in terms of area harvested, after wheat and maize. It is the main food staple for 3.5 billion people, and a linchpin of global food security. But it uses 40% of the world's irrigation water and it is responsible for 10% of global emissions of methane, a powerful greenhouse gas (GHG).

Innovative production systems such as the System of Rice Intensification (SRI), and more recently the Sustainable Rice Platform (SRP) Standard and Performance Indicators, offer proven tools to help farmers lift production while using fewer inputs and reducing methane emissions.

However, the global rice sector is extraordinarily fragmented, and most rice is grown on farms of less than 1 hectare by farmers with little or no access to credit, training, or agricultural extension services, creating barriers to wide-scale adoption of climate-smart, sustainable best practice in rice production.

A sustainable production path is vital to the security of major rice producing and consuming countries, and to meeting a global need to mitigate and adapt to climate change while contributing to achieving the Sustainable Development Goals by 2030.

FACT 1
3.5 BILLION PEOPLE DEPEND ON RICE AS THEIR MAIN STAPLE FOOD

FACT 2
GLOBAL PRODUCTION IS EXPECTED TO FALL 15% BY 2050 DUE TO CLIMATE CHANGE

FACT 3
RICE CONSUMES 40% OF THE WORLD'S IRRIGATION WATER

FACT 4
RICE PRODUCES 10% OF GLOBAL METHANE EMISSIONS

FACT 5
48 COUNTRIES SEEK TO INVEST IN CLIMATE-SMART RICE IN THEIR NDCS

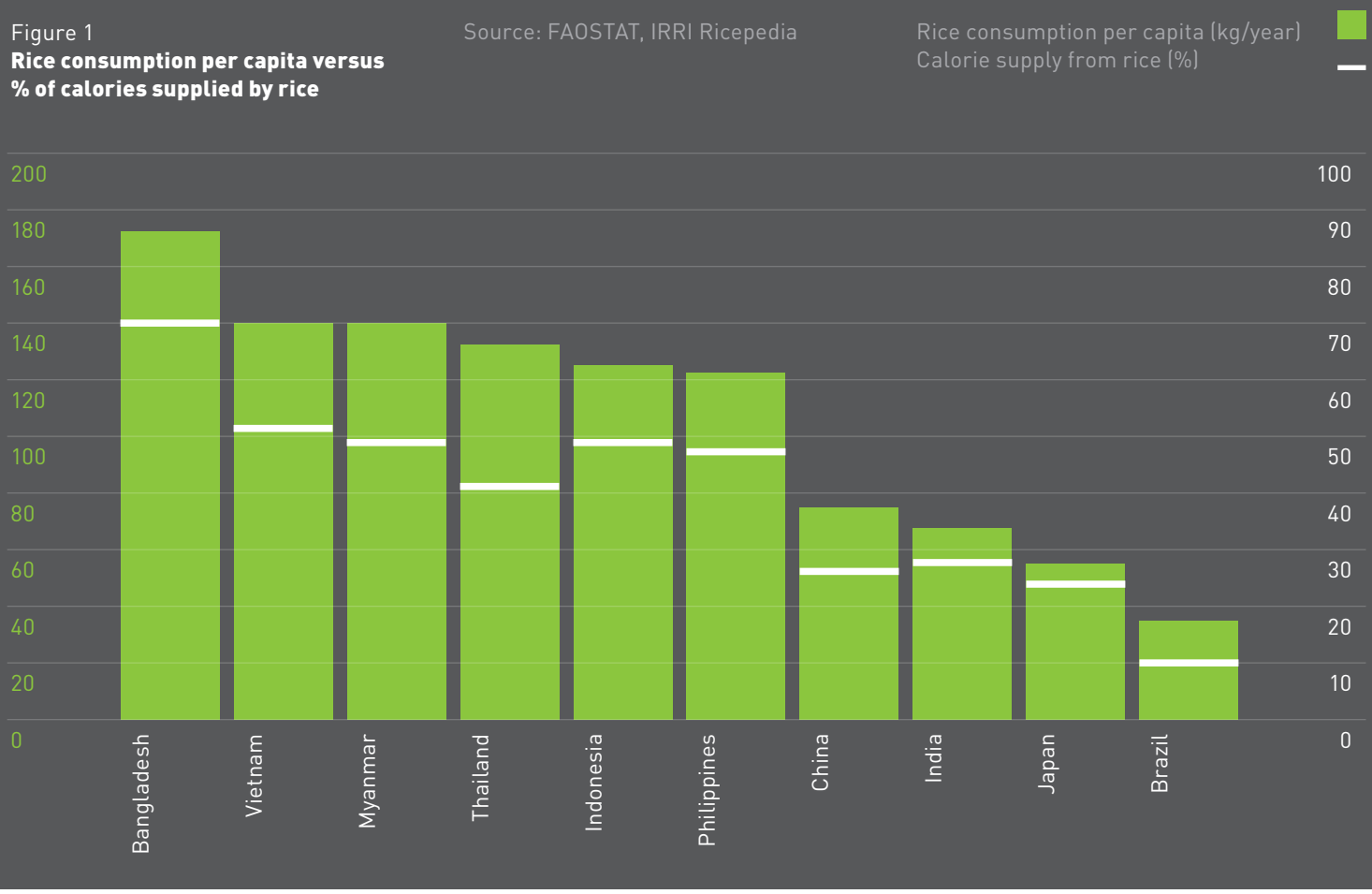
FACT 6
1 BILLION LIVELIHOODS DEPEND ON RICE FARMING

FACT 7
RICE PRICES ARE HIGHLY SENSITIVE TO CLIMATE SHOCKS AS LESS THAN 10% OF GLOBAL RICE PRODUCTION IS TRADED INTERNATIONALLY

FACT 1
3.5 BILLION PEOPLE DEPEND ON RICE AS THEIR MAIN STAPLE FOOD

Figure 1
Rice consumption per capita versus % of calories supplied by rice

Source: FAOSTAT, IRRI Ricepedia



Higher rice prices due to climate change and resource scarcity will force households in Asia and Africa into poverty.

Rice is vital to the food security of over half the world's population.[1] Asia continues to account for 90% of rice consumption, with China alone accounting for around a quarter. In lower-income countries such as Bangladesh, Cambodia and Vietnam, up to 70% of people's dietary energy comes from rice. Demand for rice is also growing rapidly in Sub-Saharan Africa, which is mostly dependent on imports.

In both Asia and Africa, most rice consumers are poor and rice accounts for a substantial proportion of household expenditure — in Myanmar, the average household spends 13% of its income on rice.[2]

These consumers are not in a position either to spend more on rice or to change to other staples. As a result, any major incidents affecting availability or price of rice — such as harvest failures, a fall in export volumes or sudden price rise — would jeopardise the food security of millions of people and increase hunger and poverty across the developing world. In Cambodia, for example, it is estimated that a 10% rise in the rice price could lead to a 0.5% increase in the poverty rate, dealing a severe blow to poverty reduction efforts.[3]

A study conducted after skyrocketing rice prices led to a food crisis in 2007-08 showed that a 50% increase in the rice price would on average increase the poverty headcount across central and west Africa by 2.2 percentage points.[4]

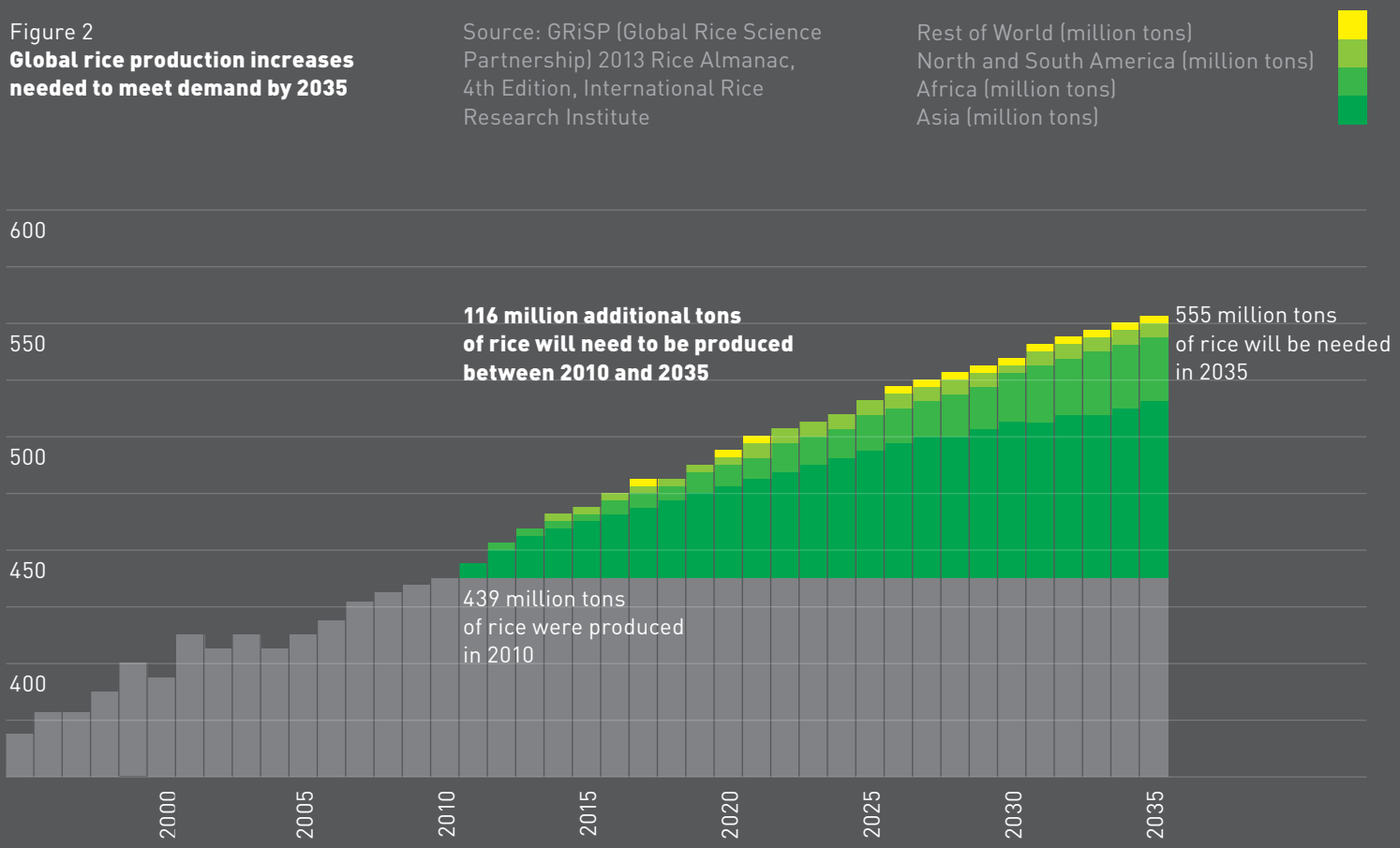
Meanwhile, in producing countries such as India and Bangladesh, falling rice yields represent an existential threat to many rural livelihoods, with millions of smallholders at risk of falling into poverty.[5] [6]

Falling household incomes and increasing poverty would also have longer-term consequences for community and national development. During periods of high rice prices, poor households are forced to prioritise spending on basic sustenance over other needs such as health and education.[7] Higher food prices thus act as a brake on development by preventing households from investing in their longer-term future.

FACT 2
GLOBAL RICE PRODUCTION IS EXPECTED TO FALL 15% BY 2050 DUE TO CLIMATE CHANGE

Figure 2
Global rice production increases needed to meet demand by 2035

Source: GRiSP (Global Rice Science Partnership) 2013 Rice Almanac, 4th Edition, International Rice Research Institute



Climate change could cut rice cultivation by up to 80% in the Sahel.

Even as global demand for rice continues to rise, climate change is imposing additional pressure on critically scarce water resources and reducing the availability of land suitable for rice cultivation. The International Food Policy Research Institute (IFPRI) says that by 2050, stresses due to climate change could reduce productivity by 10-15% in key growing areas.[8] Given the importance of rice production in deltaic regions — such as Vietnam's Mekong Delta, Thailand's Chao Phraya Delta and Myanmar's Irrawaddy Delta — seawater intrusion into rice-growing areas resulting from rising sea levels is increasingly impacting on production.

Excessive salinity in soil and water negatively impacts rice growth and yields, and rising sea levels are exacerbating the problem. Saline conditions are expected to become increasingly widespread in deltaic production areas, potentially reducing yields by 15% in some of the world's premier rice-growing areas.[9] Other impacts of climate change — including higher temperatures, changes to rainfall patterns and extreme weather events — are also likely to compound this negative impact on rice productivity.

Rice is vulnerable to high temperatures, particularly during the reproductive phase and at night. In recent years, high temperatures have led to crop losses in Asian countries including Japan, Vietnam, Pakistan and Bangladesh.[10]

In Africa, rising temperatures will make highland areas of East Africa more suitable for rice cultivation, but could cut cultivation in the Sahel region of West Africa by as much as 80%.[11] In the major rice-growing regions of Asia, computer simulations have shown yields falling by up to 10% with every 1°C increase. Drought, crop loss due to prolonged flooding of rice fields, and an increased incidence of pests and disease epidemics are also likely to reduce rice yields. In Vietnam's Mekong Delta and Bangladesh, studies show that higher temperatures and the resulting fall in rice production are a leading driver of migration to cities.[12] [13]

FACT 3
RICE CONSUMES 40% OF THE WORLD'S IRRIGATION WATER

Almost 30% of the world's rice is produced in regions that are already experiencing water stress.

It takes 3,000–5,000 litres of water to produce a single kilogram of rice, more than any other staple crop.[14] In all, rice receives 34–43% of the world's irrigation water and 24–30% of its developed freshwater resources.[15] The water intensity of rice cultivation, coupled with dwindling water resources in many rice-growing areas, represent a serious obstacle to expanding rice cultivation and indeed even to maintaining current levels of production.

The use of groundwater to irrigate rice paddies has led to a fall in groundwater levels in northern China and large parts of India, casting doubt on the future of rice cultivation in those areas.[16] By 2025 it is expected that some 15–20 million hectares (ha) of irrigated rice will suffer from some degree of water scarcity.[17]

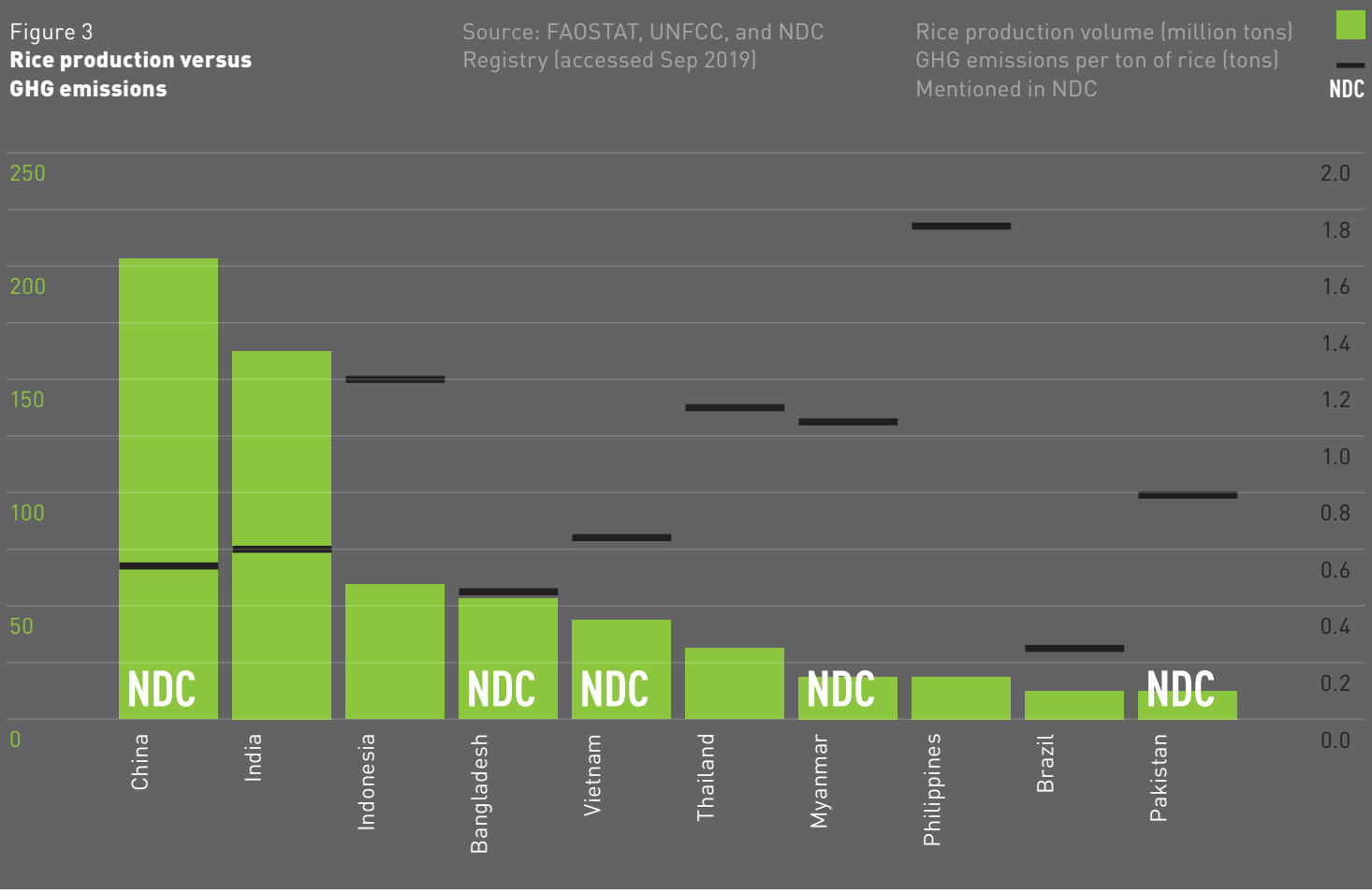
In India, the Philippines and Indonesia, water scarcity is preventing the expansion of rice cultivation into new areas to satisfy growing demand.[18] The situation is further complicated by the fact that in many key rice-growing countries, competition for water is increasing due to growing demand from industrialization and for domestic consumption in cities.[19]

In some cases, conflicts among users have arisen, which can spill over into transboundary water conflicts.[20] For example, competition for water from the Cauvery river in southern India is the main cause of a long-running conflict between rice farmers in the neighbouring states of Tamil Nadu and Karnataka.[21]

FACT 4
RICE PRODUCES 10% OF GLOBAL METHANE EMISSIONS

Figure 3
Rice production versus GHG emissions

Source: FAOSTAT, UNFCC, and NDC Registry (accessed Sep 2019)



In the 'rice bowl' region of Southeast Asia, rice accounts for 25–33% of methane emissions.

Of the three major GHGs (carbon dioxide, nitrous oxide and methane), rice sequesters carbon but emits nitrous oxide and methane. Rice is the source of 10% of global anthropogenic methane emissions.[22] In Southeast Asia — the world's premier rice bowl — rice cultivation accounts for up to 25-33% of the region's methane emissions, and between 10-20% of its overall greenhouse gas emissions.

While methane emissions are caused by a number of factors, water management, tillage practices and fertiliser use are key. In flooded rice soils, the water blocks oxygen from penetrating the soil, creating ideal conditions for bacteria that emit methane.

Proven techniques such as Alternate Wetting and Drying (AWD) can reduce emissions by up to 50%. These methods can also conserve water and boost yields. Improper management of residues such as rice straw and husks is an additional factor. Across the world, farmers typically either leave these to be submerged in the paddy (where they decompose and release methane) or else burn them (releasing carbon dioxide along with soot). Adopting sustainable practices such as removal of rice straw from the field can reduce methane emissions by 70%. However, capacity building and market incentives are needed to encourage widespread adoption of these practices, for example by creating new applications and revenue streams for rice straw products.[23]

FACT 5
48 COUNTRIES SEEK TO INVEST IN CLIMATE-SMART RICE IN THEIR NDCS

162 countries have submitted their Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC).

NDCs lie at the core of national strategies for reducing greenhouse gas emissions in line with the Paris Agreement.[24] Of these 162 countries, 127 list agriculture as a priority for climate mitigation efforts, with 104 including specific agriculture sector pledges.[25] Of these, 48 countries include commitments to reduce GHG emissions from rice in their NDCs. Four of the world's 10 largest rice producers refer specifically to rice in their NDCs (Bangladesh, China, Myanmar and Vietnam), while the other six do not (Brazil, India, Indonesia, Pakistan, Philippines and Thailand).

A first policy action for these countries would be to incorporate opportunities for emissions reductions from rice cultivation as part of their respective NDCs. For example, in Thailand, the world's sixth-largest rice producer and the second biggest exporter, rice accounts for 8% of total greenhouse gas emissions. Despite this, while Thailand's NDC does refer to the need to reduce agricultural emissions, rice is not specifically mentioned.

By contrast, Bangladesh — the world's fourth-largest rice producer where the rice sector accounts for 13% of total GHG emissions — has gone further than other major rice producers in setting specific targets to reduce emissions from rice. Its NDC includes a commitment to scaling up Alternate Wetting and Drying (AWD), a practice that can reduce methane emissions by 50%, to cover at least 20% of rice production by 2030.[26]

Although the NDCs of 67 countries acknowledge the private sector's role in financing climate adaptation and mitigation, very few refer to specific actions the private sector can take, and none specifies actions private companies should take in relation to rice.[27] Only 18 countries refer to specific financial mechanisms (such as credit and insurance) that will need to be extended to farmers to incentivize adoption of climate-smart best practice, including a small number of rice-producing countries such as Nigeria and Pakistan.

This gap highlights the need and the urgency to develop mechanisms to facilitate coordinated large-scale private sector initiatives specific to rice, in support of governmental efforts under their respective NDC commitments to emissions reduction.

FACT 5

48 COUNTRIES SEEK TO INVEST IN CLIMATE-SMART RICE IN THEIR NDCS

Figure 4
Top 10 Rice Producers and their Nationally Determined Contributions (NDCs)

Source: UNFCCC, NDC Registry, Accessed Sept 2019

Ranking	NDC Inclusion	NDC Commitment on Rice
1 China	NDC	Commits to control methane emissions from rice fields and nitrous oxide emissions from farmland; and to build a recyclable agriculture system, promoting the comprehensive use of straw.
2 India		No explicit commitment on rice. The agriculture sector is included in the country's adaptation plans with commitment to enhance investment in climate vulnerable sectors.
3 Indonesia		No explicit commitment on rice. Commits to reducing GHG emissions from agriculture by up to 0.32% but no further detail is given.
4 Bangladesh	NDC	Commits to scale up rice cultivation using Alternate Wetting and Drying for 20% of all rice cultivation, raising productivity of agricultural land and lowering emissions of methane.
5 Vietnam	NDC	Commits to reduce GHG emissions from rice. Rice is also seen as key in climate adaptation: 'Up to 39% of the Mekong Delta could be submerged, affecting 35% of the population and causing the risk of losing 40.5% of the total rice production in this region.'
6 Thailand		No explicit commitment on rice. However, it commits to mitigate economy-wide GHG emissions by at least 20% by 2030, including from agriculture. The government is investing in measuring GHG emissions from rice and supporting sustainable rice projects that adopt the SRP standard with the goal of reducing GHG emissions from rice by 26%.[28]
7 Myanmar	NDC	Commits to mitigate GHG emissions from the agriculture sector and growing rice in paddy fields. Methods include alternate wetting and drying, organic fertiliser use, and improved rice straw management.
8 Philippines		No explicit commitment on rice. However, commits to reduce greenhouse gas emissions by 70% by 2030 and includes climate-smart agriculture in adaptation commitments.
9 Brazil		No explicit commitment on rice. However, commits to reduce greenhouse gas emissions by 37% below 2005 levels by 2025, including through strengthening the existing Low Carbon Emission Agriculture Program (ABC).
10 Pakistan	NDC	Commits to manage water in rice cultivation to control release of methane from agricultural soils and introduce low water dependent rice varieties.

FACT 6
1 BILLION LIVELIHOODS DEPEND ON RICE FARMING

Women farmers play a vital, and often unrecognised role. In South Asia, they contribute as much as 80% of labour.

Rice differs from other major global staples (such as maize and wheat) in that it is disproportionately grown and consumed by the world's poor. Rice is a key product and staple food in Least Developed Countries (LDCs) in Asia such as Bangladesh, Cambodia, Lao PDR and Myanmar. Moreover, rice is the main staple food in several African LDCs, including Madagascar, Guinea, Guinea-Bissau, Sierra Leone, and Senegal.

Not only is rice disproportionately consumed by the poor — it is produced by them too. Overall, more than a billion people worldwide depend on rice for their livelihoods, either as farmers or other actors within the value chain, or as their family members and other dependents.[29] The overwhelming majority live in low or middle-income countries — which account for 94% of global rice production — and operate small farms of 1 hectare or less (in Asia and Africa, though not in Latin America).[30]

Most of these are in remote rural areas, so farmers have little option but to sell their rice to middlemen for a fraction of its eventual market value.

The number of smallholder farms in rice (~144 million) is far higher than for any other crop.[31] Smallholders are price-takers with low bargaining power, limited access to finance, services, and infrastructure, and lack incentives for quality and product differentiation.[32] There is limited coordination between actors and, even in more developed markets such as India, middlemen can still proliferate, distancing farmers further from their markets.[33] Historically, farmers have been relatively powerless in the value chain, with larger players exerting greater influence. Many farmers across different rice producing countries have therefore organised themselves in cooperatives to improve negotiating leverage and economies of scale in procuring inputs and services, and in marketing produce. In Africa, farmers have reported price gains of around 300% by selling through co-operatives rather than to local agents.[34]

Women farmers play a vital and often unrecognised role in rice farming. Women in Southeast Asia contribute up to 60% of the required labour and in South Asia the proportion can be as high as 80%. Women are also disadvantaged in terms of land ownership. For example, although most rice workers in Tanzania are female, they own only 19% of titled land.[35]

Increasing productivity is key to reducing poverty and improving livelihoods. In China, Japan and South Korea, the gap between actual and potential yields has been reduced effectively, with further yield increases mostly possible through genetic innovation. However, in countries such as Bangladesh, Cambodia and Myanmar as well as rice-growing areas of Sub-Saharan Africa, a substantial yield gap remains and better crop management techniques and expanded irrigation can lift production. However, the very fact that most rice farmers are resource poor limits this potential. With incomes barely enough to cover basic needs, and little or no access to credit or other sources of finance, farmers cannot invest in farm operations to make them more productive and sustainable.

FACT 7
RICE PRICES ARE HIGHLY SENSITIVE TO CLIMATE SHOCKS AS LESS THAN 10% OF GLOBAL RICE PRODUCTION IS TRADED INTERNATIONALLY

A poor harvest, extreme weather events or export restrictions in a leading producer country can quickly trigger global price volatility.

Rice differs from other staples such as wheat and maize in that it is overwhelmingly consumed in the countries where it is grown, most of them low- and middle-income countries. Although rice is grown in more than 100 countries worldwide, 90% of global production is in the hands of nine Asian countries: China, India, Indonesia, Bangladesh, Vietnam, Thailand, Myanmar, the Philippines and Japan. Brazil is the only non-Asian country among the top 10 global producers.

While only a small proportion of rice is exported, a large and growing number of rice-consuming countries in the world, notably in West Africa, depend on imports from a small number of exporting countries in Asia, primarily India, Thailand and Vietnam.

In such a thinly traded market, production shocks or changes to trade policy in one or more of the big exporting countries can have a major impact on availability and price of rice in international markets, with potentially serious consequences for consumers in importing countries. Price volatility offers a compelling rationale for a global transformation towards sustainable rice production as a means of ensuring market resilience.[36] [37]

Prices could increase by 70% in the next 10 years driving poverty and instability around the world.

According to Oxfam, processed rice prices could rise by up to 31% by 2020 and 73% by 2030, compared with 2010 prices.[38] In 2007-08, export restriction by countries such as India and Vietnam pushed prices up by as much as 224%.[39] In West African countries such as Senegal that depend heavily on rice imports, prices skyrocketed and many households were plunged into food insecurity. Indeed, according to the same Oxfam study, Senegal's high per capita rice consumption and dependence on imports make it the most vulnerable country globally to a rice price surge.[40]

Rice-producing countries tend to respond to production falls by restricting exports in order to shore up domestic food security. Consumers in poor countries who depend heavily on imported rice are particularly vulnerable to the economic impact of sudden price volatility.

Price increases may also trigger larger-scale social upheaval in rice-producing and consuming nations. The 2007-08 food price crisis led to demonstrations and riots in West African countries including Burkina Faso, Guinea, Cameroon, Cote d'Ivoire and Senegal.[41] In extreme cases, unrest could lead to political unrest — a particular concern given the already weak political stability and ongoing armed conflicts in many West African countries. Although West Africa's governments emerged largely intact from the unrest of 2007-08, that same year, riots in Haiti, sparked in part by increased hunger due to a spike in the price of imported rice, led to the fall of the government.[42] [43]

Figure 5
Global Rice Trade

Top exporters of rice	$ billion
India	7.050
Thailand	3.000
Vietnam	1.750
United States	1.650
Pakistan	1.630

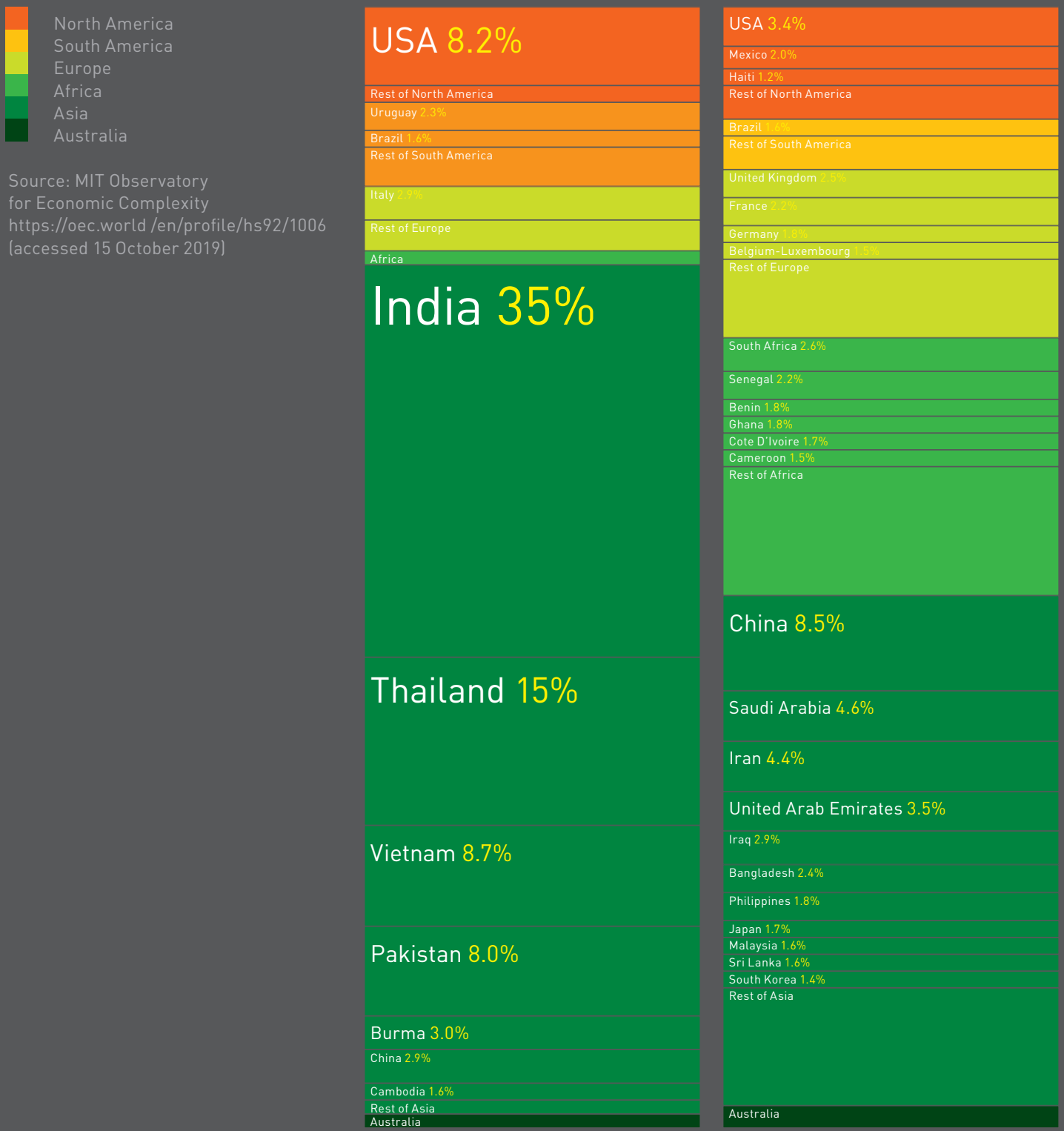
Top importers of rice	$ billion
China	1.720
Saudi Arabia	0.933
Iran	0.891
United Arab Emirates	0.706
United States	0.686

Rice as top import	$ billion
Haiti	0.250
Sierra Leone	0.190
Guinea-Bissau	0.048

IN 2007–8 THE RESTRICTION ON RICE EXPORTS BY COUNTRIES SUCH AS INDIA AND VIETNAM HELPED TO PUSH INTERNATIONAL RICE PRICES OVER 200%

FACT 7
RICE PRICES ARE HIGHLY SENSITIVE TO CLIMATE SHOCKS AS LESS THAN 10% OF GLOBAL RICE PRODUCTION IS TRADED INTERNATIONALLY

Figure 6
The $20.2 billion Global Rice Trade



Source: MIT Observatory for Economic Complexity https://oec.world /en/profile/hs92/1006 (accessed 15 October 2019)

2 REGIONAL HOTSPOTS

2.0
ADAPTATION HOTSPOTS IN SMALL TROPICAL COUNTRIES

While China and India are the world's largest producers, the report focuses on Southeast Asia and West Africa — two regions that have a significant potential to increase production sustainably, but due to their small national territories and tropical climates they are critically vulnerable to the combined impacts of climate change, water scarcity and food insecurity.

Under a business-as-usual scenario, the Intergovernmental Panel on Climate Change (IPCC) anticipates that rice production will fall across the world, but will affect countries differently. Asia will be particularly hard hit due to a convergence of land degradation, climate change, and water scarcity.[44]

Larger rice-producing countries such as India and China, with large territories that cover a range of climatic zones, will have more space to shift rice cultivation to cooler areas that will become suitable for growing rice. However, smaller producers and importers in the tropical belt, such as countries in Southeast Asia and West Africa, lack such flexibility to adapt.

These regions are already facing the direct impacts of climate change and water scarcity, together with adverse consequences for livelihoods and food security.[45] The impacts will be most severely felt by small countries with tropical climates, which will see lower rice yields and production shortfalls, and could gradually become less suitable for rice cultivation.

As prices increase, poverty rates in some non-agricultural household groups in Asia and Africa could rise by 20-50%.[46] Oxfam has assessed the vulnerability of different countries to rice price surges, based on the importance of rice to the local diet and the share of imports in domestic rice cultivation.

Senegal was identified as the country most at risk, as rice accounts for nearly half of total crop demand. The country's high dependence on rice imports renders it extremely vulnerable to supply shortages and price hikes. Other heavily-exposed countries and regions included Nigeria, Mozambique, Mauritius, Botswana, South Africa, Malaysia, and the Caribbean.[47]

POVERTY RATES IN SOME NON-AGRICULTURAL HOUSEHOLD GROUPS IN ASIA AND AFRICA COULD INCREASE BY 20–50%

2.1 SOUTHEAST ASIA

The countries of mainland Southeast Asia boast large river deltas with ample amounts of fresh water and flat land ideal for rice cultivation. As a result, rice is a major agricultural commodity in these countries — accounting for up to 80% of total crop area.[48]

The two main rice producers in the region are Thailand and Vietnam, currently the world's second- and third-largest rice exporters. Myanmar and Cambodia are the fifth- and eighth-largest exporters, and both have significant potential to scale up production.

With global demand for rice continuing to rise and limited potential to expand yields in traditional producers such as China, the countries of mainland Southeast Asia are poised to take centre stage as the world's rice bowl if they can increase their resilience to social and environmental pressures. However, climate change and labour shortages threaten rice production in a region that feeds an ever-larger share of the world's rice consumers. Major rice producers such as Thailand and Vietnam produce rice for their own populations, as well as exporting to other regions, even other traditional producers in the region such as Indonesia and the Philippines, which are increasingly turning to imported rice to keep their populations fed.

2.1
SOUTHEAST ASIA

Figure 7
Featured Countries

Myanmar

Myanmar is the seventh-biggest producer and fifth-biggest exporter of rice. Average yields are low at just 2.7 tonnes/hectare (t/ha), so there is substantial scope to increase production and exports. However, challenges include farmers' limited access to inputs and lack of agricultural know-how, weak road and port infrastructure, and an inefficient milling sector.[49]

Thailand

The world's second-largest rice exporter, Thailand exports more than 11 million tons per year, much of it low-quality white and parboiled rice for consumers in Asia and Africa. Although the sector is more developed than in some neighbouring countries, production is constrained by low yields and an ageing agricultural workforce; the average age of rice farmers is 56.[50]

Cambodia

Rapid yield gains since the 1990s mean that Cambodia is today the world's seventh-largest exporter of rice. However, yields are still the lowest in the region due to lack of access to basic inputs such as fertilisers, high-quality seeds, energy, credit, and training — deficiencies that will need to be remedied if the country is to scale up production and become a net exporter of rice.[51]

Vietnam

Vietnam is currently the fifth-largest rice producer in the world and the third-largest exporter, with a relatively high average yield of nearly 6 tonnes/hectare. However, both rice yields and the amount of land suitable for rice cultivation are threatened by saltwater intrusion in the Mekong Delta as well as reduced freshwater flows due to the construction of upriver dams.[52]

2.1
SOUTHEAST ASIA

Selected Priority Areas for Impact

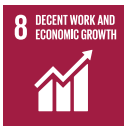
Sustainable rice partnerships can have a strategic impact aligned with attainment of the UN Sustainable Development Goals (SDGs) on the following social, environmental and development pressures that are material to the development of the rice industry:

SDG 1
Land tenure security

Despite ongoing land reform processes, inefficiencies in titling and registration mean that many farming households in Myanmar, Vietnam and Cambodia still lack secure land tenure. In Myanmar, where land rights are least secure, the absence of legal protections for farmers puts them at risk of eviction.[53] Lack of secure tenure is an obstacle to increasing rice yields as it makes farmers less willing to upgrade their operations. Studies in Cambodia have shown that farmers with secure land title are more likely to invest in productive farm assets and on-farm irrigation, and experience higher yields as a result.[54]

Across mainland Southeast Asia, land titling and registration processes must be improved, and more accurate land registries created. Supporting the rollout of digital methods such as satellite-based surveying and digital land registries would help make land titling more efficient and accurate, giving smallholders the security to invest more in their operations.[55] Judging by the case of Cambodia, this could lift rice yields more than 30% and household disposable income by 18%.[56]

SDG 8
Access to finance



Access to finance varies widely across Southeast Asia: while over 80% of adults in Thailand have a bank account, in other countries fewer than 50% do, with just 22% of Cambodians having one.[57] In countries such as Myanmar and Cambodia, farmers lack access to the most basic financial products, such as loans that would allow them to obtain the basic inputs needed to upgrade their operations, such as seeds and fertilisers.

In Thailand, access to credit is more widespread, but many farmers still lack crop insurance, putting them at risk in the event of extreme weather or outbreaks of pests or disease. A sizeable and growing proportion of Southeast Asians have access to mobile and Internet services, including smartphones. Currently, 63% of people in the region have access to the Internet and in Cambodia the number of Internet users grew by 56% in 2018 alone.[58]

In this context, the foundations are in place to increase rice smallholders' access to finance through digital financial services, including payments, credit, savings and insurance managed through mobile and internet banking.[59] To make them as valuable and useful as possible to smallholders, digital financial services could be bundled together with e-agriculture services such as digital extension services and up-to-date information about weather and markets.

2.1
SOUTHEAST ASIA

SDG 9
Infrastructure gap

Across mainland Southeast Asia, particularly in Cambodia and Myanmar, transport infrastructure is inadequate and poorly maintained. This drives up both the cost of rice imports and the cost of transporting it to market. In Cambodia, for example, it costs $15 to transport a ton of rice 100km by road — twice the rate in Vietnam and three times as much as in Thailand.[60]

Poor road infrastructure also contributes to up to a tenth of rice being lost during transportation due to contamination and spillage.[61] In areas where most rice is transported on foot or by animal due to high transportation costs and inadequate roads, supporting farmers' access to motor vehicles can reduce spillage losses. Upgrading post-harvest practices — for example by giving farmers hermetic bags for storage — can also reduce grain losses by preventing contamination and spillage during transportation.

SDG 13
Extreme weather costs

Extreme weather — specifically drought, flooding and rising sea levels — is a major stress for rice production in mainland Southeast Asia. In particular, saltwater intrusion due to sea level rise could cut yields by up to 15% in the region's major rice-growing deltas, mostly due to an increase in soil and groundwater salinity.[62] Dams being built upriver in Thailand, Laos, Cambodia and Vietnam, as well as on the upper part of the Mekong (the Lancang) in China present an additional challenge.[63] [64]

By reducing the flow of freshwater and sediment to the delta, this risks exacerbating saltwater intrusion and further reducing yields. Given the importance of river deltas — such as the Mekong and Red in Vietnam, the Irrawaddy in Myanmar and the Chao Phraya in Thailand — to global rice production and food security, and the extent to which sea level rise threatens rice cultivation in these areas, there is a clear opportunity to ensure the industry's future by supporting the development, testing and adoption of rice strains that can thrive in saline conditions. Farmers could also be given access to accurate weather forecasts and early warning systems, as well as training in building coastal infrastructure such as dikes to protect against saltwater intrusion.[65]

SDG 13
GHG emissions

Across our four focus countries, the rice sector accounts for an average of 28% of methane emissions and 7.3% of total GHG emissions. This is mainly due to improper disposal of residues such as rice straw, primarily by burning straw in the field. In Vietnam's Mekong Delta, at some times of year up to 98% of residues generated during rice farming are burned.[66] Surveys of rice farmers in Thailand find that the main reason they choose to burn rice straw is the short turnaround between harvesting one crop and planting the next, which makes burning the most efficient option.[67]

Ending burning of rice straw and other residues is central to reducing the negative environmental impact of the sector and reducing overall emissions of GHGs (particularly methane) from Southeast Asia. This can be done by giving farmers financial incentives and training on improved rice straw management, by buying residues from farmers to be converted into other products (such as fertiliser, animal fodder, biofuel or building materials) or by training farmers in developing and marketing by-products from rice residues, giving them an additional revenue stream.[68] [69]

2.1
SOUTHEAST ASIA

CASE STUDY

INNOVATIVE FINANCE PARTNERSHIP: THAI RICE NAMA

CLIMATE FINANCE SUPPORTS THAI RICE FARMERS TO MITIGATE GHG EMISSIONS

As well as being a major source of export revenue, Thailand's rice sector is a major source of GHG emissions.

The sector emits a third of Thailand's methane emissions and 8% of its total GHG emissions. Nationally Appropriate Mitigation Actions (NAMAs), are climate change mitigation measures proposed by developing country governments to cut their emissions, which can be funded by international climate finance.

The Thai Rice NAMA Project aims to mitigate emissions from agriculture by supporting rice farmers in central Thailand to adopt four climate-smart practices: Alternate Wetting and Drying (AWD), laser land levelling, improved rice straw management, and site-specific nutrient management (SSNM). It is anticipated that the project will reduce GHG emissions by 20.5% compared to a business-as-usual scenario. It will also increase smallholders' incomes by an average of 157% by reducing expenditures on inputs such as water and fertiliser.

The NAMA Facility, a multi-donor fund, is providing $17.3 million for the project, which is being implemented by the Thai government and German Corporation for International Cooperation (GIZ). Actors in the rice value chain can access funding from two mechanisms.

— The Revolving Fund is supported by NAMA grant funds and supports farmers to invest in switching to low-emissions production methods without going into debt. In particular, farmers can access financing to pay for costly land-levelling services, which they can pay back over a period of time while service providers are paid upfront from the fund.

— The other funding mechanism is a subsidised loans programme implemented by the Bank for Agriculture and Agricultural Cooperatives (BAAC), which allows service providers (such as companies offering laser land levelling services) to invest in technology.

The project expects to generate $23.8 million in funding from the private sector for innovative financial incentives. The Thai government has earmarked at least another $27.7 million annually in agriculture- and mitigation-related areas.[70] The project is currently being implemented across six provinces across central Thailand (Chainat, Ang Thong, Pathum Thani, Supanburi, Ayutthaya and Singburi) and is expected to lead 100,000 rice farming households to switch to low-emissions rice farming by 2023. If it meets its targets, the project will result in the large-scale dissemination of Sustainable Rice Platform (SRP)-compliant rice farming practices across central Thailand.[71]

2.2 WEST AFRICA

West Africa is not a traditional centre of rice production or consumption, but the region's growing profile as a major consumer of rice and a fast-growing primary destination for Asia's rice exports means it must be included in discussions about the future of the global rice sector.

While rice plays an increasingly important role in diets across the region (supplying 30–40% of calorie intake in some countries), our analysis focuses on Nigeria, Mali, Senegal and Côte d'Ivoire. These four countries are the main producers and consumers of rice in West Africa. They are driving regional trends and are emblematic of the challenges and opportunities affecting rice in the region.

These include growing demand, low yields, and (with the exception of Mali) growing reliance on imports from Asia. More than half of the region's rice is imported.[72] The region must boost its food security while also reducing vulnerability to supply-side disruptions and price shocks. To achieve this, domestic production must be increased in a sustainable way. However, this task is complicated by challenges including low productivity and quality as well as water stress amplified by climate change.

2.2
WEST AFRICA

Figure 8
Featured Countries

Senegal

Senegalese get a third of their daily calories from rice, just 27% of which is grown in the country.[73] Given the importance of rice to the Senegalese diet and the country's heavy reliance on imports, Senegalese consumers are highly vulnerable to any disruption in supplies from Asia or fluctuation in the global rice price.

Côte d'Ivoire

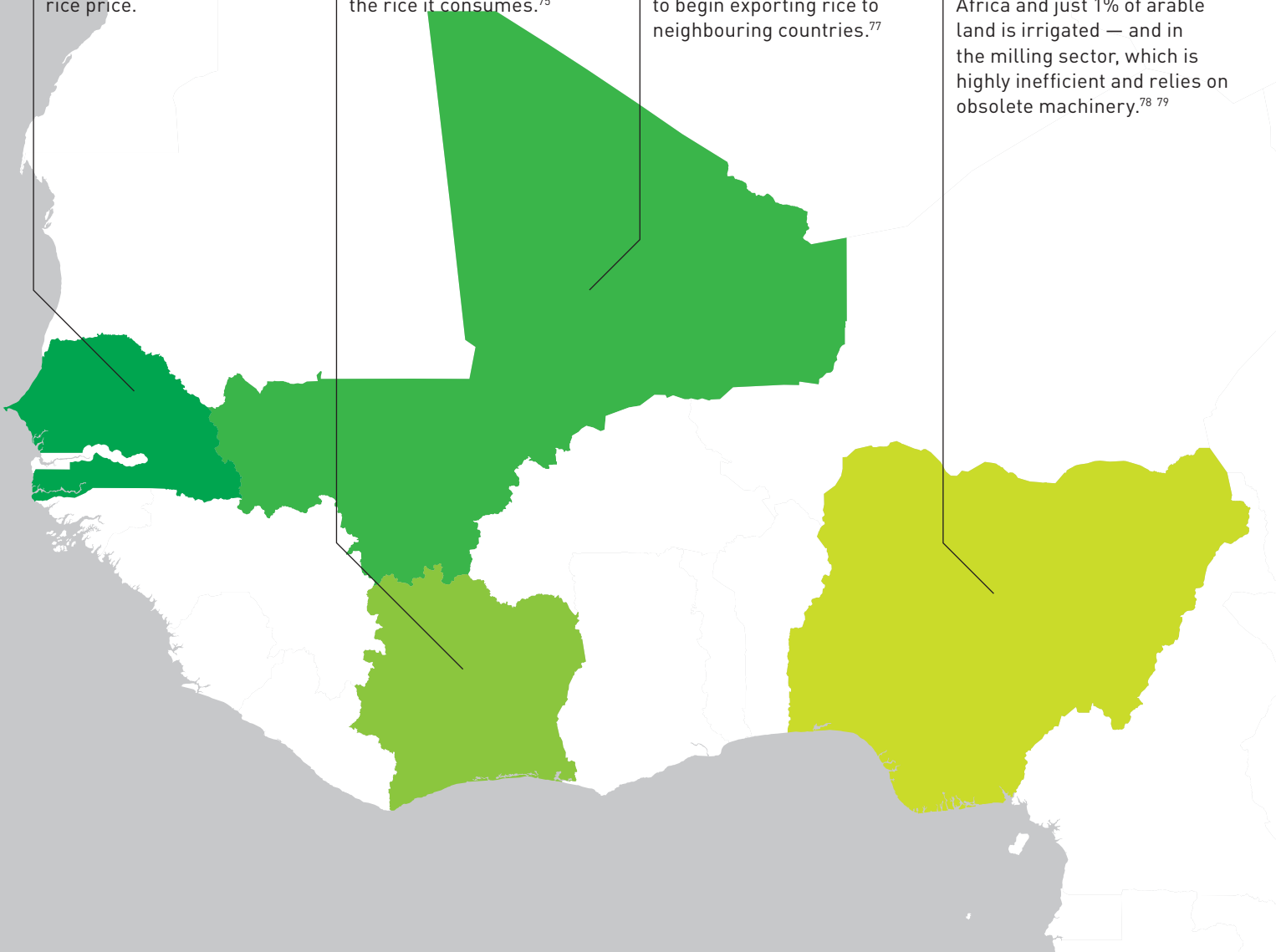
At nearly 70kg of rice per capita per year, Ivorians' rice consumption is among the highest in West Africa. Although the country's climate and abundant rainfall make it well suited to rice cultivation, smallholders are reluctant to cultivate rice, preferring cash crops such as cocoa and cashew.[74] As a result, the country imports nearly half of the rice it consumes.[75]

Mali

Mali produces 90% of the rice it eats, making it the West African country that is closest to achieving self-sufficiency and indeed becoming a net exporter of rice.[76] However, substantial production constraints — including low levels of agronomic know-how, weak access to inputs and inefficient irrigation — must be overcome if it is to begin exporting rice to neighbouring countries.[77]

Nigeria

The biggest rice producer in Sub-Saharan Africa, Nigeria nevertheless relies heavily on imports from Asia — despite government efforts to boost domestic production by imposing a 70% tariff on imported rice. There are serious constraints to scaling up production both at the farm level — fertiliser use is the lowest in Sub-Saharan Africa and just 1% of arable land is irrigated — and in the milling sector, which is highly inefficient and relies on obsolete machinery.[78] [79]



2.2
WEST AFRICA

Selected Priority Areas for Impact

Sustainable rice partnerships can have a strategic impact aligned with attainment of the UN Sustainable Development Goals (SDGs) on the following social, environmental and development pressures that are material to the development of the rice industry:

SDG 2
Food and nutrition security

Across West Africa, and particularly in Sahelian countries such as Mali and northern Nigeria, there are high levels of food insecurity linked to poverty, adverse climatic conditions, and armed conflict. Across our four countries, 12.5% of the population suffers from under-nourishment, and rates are much higher in certain areas, such as northern Nigeria and the Casamance region of Senegal.[80]

Rice's increasing importance as a dietary staple makes food security in these countries heavily dependent on the continued availability of plentiful and affordable rice. Any disruption in supply or significant increase in price would undermine food security, particularly amongst the poorest and most vulnerable sectors of the population. West Africa has substantial unfulfilled potential to produce rice, at least in part because consumers believe imported rice to be of higher quality.

However, evidence from Senegal shows that when locally-produced rice is tailored to consumers' preferences in terms of quality and presentation, demand rises and some consumers prefer it to imported rice.[81] Upgrading processes such as cleaning, sorting and de-husking to improve the quality and appearance of locally-produced rice and tailoring presentation to local preferences could help stimulate demand for local rice and reduce consumer reliance on imports.

SDG 4
Basic education

Rates of basic education and literacy in West Africa are among the lowest in the world. Across our four countries, only 45% of adults are literate; in Mali, that drops to just 33%.[82] Literacy rates are lower in rural areas and amongst low-income groups, including rice farmers.

This significantly complicates the process of training farmers in everything from good agricultural practice to marketing their produce, as they cannot engage with written material. It also limits the impact of interventions that have succeeded in other regions with higher levels of basic education, such as text-based e-agriculture services and weather and market information.[83] Given the extent to which lack of training in good agricultural practices prevents significant gains in rice yields and quality, it is vital to develop training tools that meet the specific needs of West African rice farmers.

Given widespread illiteracy and the region's linguistic diversity, this could involve supporting the development of radio programmes or videos in local languages and their dissemination via existing channels such as rural radio stations and village cinemas.[84] Literate farmers and other value-chain actors (such as millers) could also be supported to help train and mentor their peers who cannot access written material.

2.2
WEST AFRICA

SDG 6
Water stress

The presence of major rivers such as the Niger and the Senegal gives the region plentiful freshwater resources. However, these are very unevenly distributed, with some areas suffering from acute water scarcity. In addition, Sahelian countries such as Mali, Senegal and northern Nigeria suffer from increasingly erratic rainfall and higher drought risks due to climate change. There is evidence that water scarcity is starting to affect rice yields, including in major producing areas such as Mali's Office du Niger and the Senegal River Valley.[85] There are also reports of water stress fuelling conflicts between rice farmers and other users, a trend likely to increase as water becomes scarcer.

Given the arid climate and low rainfall, particularly in Mali, expanding rice cultivation and yields will require an expansion of irrigation infrastructure. Currently, less than 5% of the land suitable for irrigation is being irrigated.[86] In Mali alone, the area suitable for growing irrigated rice has been estimated at 2.2 million hectares — just 20% of which is currently being used.[87] However, irrigation methods must be water-efficient so as to minimise the risk of water stress and conflicts between users. Expanding small-scale and village-level irrigation schemes and developing and disseminating innovative technologies such as drip irrigation could increase yields while reducing water use.[88] In Mali, it is estimated that drip irrigation could increase yields by 40-50% whilst also substantially reducing water consumption.[89]

SDG 7
Electricity access

Limited and unreliable access to electricity is a key constraint in West Africa. Across our four countries, on average 82% of businesses say power outages are a problem for business.[90] High energy costs and frequent blackouts are a major constraint for the rice industry, and in Senegal rice millers and farmers identify electricity as the biggest challenge and their largest single operating expense. Long blackouts have shut down processing operations for long periods.[91]

Inadequate electricity supply is also a key constraint for the rice processing sector in Nigeria.[92] Inadequate access to sufficient and reliable electricity makes it vital to facilitate value chain actors' access to off-grid technologies. Rice farmers and millers could be helped to obtain solar-powered irrigation pumps, rice husking machines and small-scale rice mills.[93] There is also an opportunity to support research into the possible use of rice straw and husks to power rice mills.[94]

SDG 8
Access to finance

Across the four countries, fewer than 40% of adults have access to a bank account and fewer than 10% have access to loans and credit from formal financial institutions.[95] Lack of access to credit is a key barrier to upgrading the rice value chain across West Africa. Without loans, farmers cannot buy the basic inputs they need to become more profitable and sustainable, such as improved seeds, machinery and fertilisers.

In Cote d'Ivoire, liquidity constraints mean that millers cannot pay farmers for their rice without delay, leading farmers to sell instead to traders and not repay the money advanced to them by the mills for inputs.[96] The precarious financial situation facing both rice farmers and millers helps to weaken the value chain. The poor penetration by banks and other formal financial institutions in much of rural West Africa means that scaling up access to credit through banks alone is unlikely to be viable.

A range of options to develop digital finance platforms for agricultural value chains are already at play across Africa and can be strengthened. In addition, developing collateral and guarantees for farmers to access finance, as discussed in the next section of this report, presents opportunities to broaden access to finance and strengthen the value chain.[97] Credit could also be bundled with other inputs that farmers urgently need and that mills are well placed to provide, such as seeds, fertiliser and agricultural extension support.

2.2
WEST AFRICA

CASE STUDY
SMART IRRIGATION
TRANSBOUNDARY COLLABORATION KEY TO UNLOCKING SUSTAINABLE RICE IN WEST AFRICA

In order to scale up rice production in West Africa and improve livelihoods and food security, better water control — particularly through irrigation — is urgently needed. Although the region is home to several large irrigation schemes such as the Office du Niger in Mali, substantial investment is needed both in rehabilitating existing systems to ensure that they achieve their full potential, and in bringing new areas under irrigation. Merely doing this could raise paddy yields in some areas by nearly 300%. This in turn would raise household incomes, reduce poverty; improve food security and nutrition, resilience to shocks and climate change; and empower women.[98]

Transboundary collaboration on irrigation provides a framework for action

Since the 1970s, regional and international institutions such as the International Finance Corporation and the African Development Bank have supported irrigation projects in West African countries such as Senegal, Burkina Faso and Niger. However, a significant step forward occurred in 2013, when the High-Level Forum on Irrigation in Dakar (Senegal) brought together governments and international organisations to discuss the future of irrigation in the countries of the Sahel (Burkina Faso, Chad, Mali, Mauritania, Niger and Senegal).

Following the forum, the governments of those six countries issued the Dakar Declaration, in which they pledged to expand the total irrigated area in the Sahel to one million hectares.[99] The Dakar Declaration led to the Sahel Irrigation Initiative (2iS), which aims to support the six countries to scale up irrigation. 2iS's Strategic Framework emphasises the need to prioritise small-scale irrigation systems as well as large-scale projects; and co-ordinate the development of irrigation projects across transboundary basins. This will require plans to be co-ordinated within river basin management organisations so that investments can contribute to a peaceful and efficient use of scarce transboundary water resources.

PARIIS: World Bank-funded project aims to irrigate 23,000 hectares in the Sahel

By far the most significant project so far developed in line with the 2iS strategy is the Sahel Initiative Support Project (PARIIS). The project has been awarded $170 million by the World Bank: $25 million for each of the six countries, with the rest reserved for regional initiatives. In addition to financing irrigation projects, the money will be used to strengthen the institutional framework for land and water management and to develop a regional irrigation knowledge sharing system. The project aims to develop schemes covering 23,000 hectares, benefiting 58,000 farmers and more than 400,000 people.[100]

Investment alignment with national agriculture strategies

In light of the 2iS strategic framework's emphasis on tailoring irrigation projects to local conditions and the needs of stakeholders, the agriculture and irrigation strategies developed by individual governments will be key to investment. All West Africa's major rice producers signed the African Union's CAADP (Comprehensive Africa Agriculture Development Programme) Compact, which includes a commitment to scale up irrigation to double agricultural productivity.[101]

2.2
WEST AFRICA

CASE STUDY
SMART IRRIGATION
TRANSBOUNDARY COLLABORATION KEY TO UNLOCKING SUSTAINABLE RICE IN WEST AFRICA

As part of their CAADP commitments, all the major West African rice producers have submitted a National Agricultural Investment Plan (NAIP) — and most of these establish specific targets to expand the irrigated area or promote specific types of irrigation system. For example, Nigeria sets the goal of rehabilitating and completing existing irrigation projects and expanding the irrigated area from 1% of total land area to 10%.[102] Mali and Senegal, meanwhile, pledge to promote small-scale irrigation and drip irrigation respectively.[103] [104]

In some cases, the NAIPs are complemented by existing national irrigation strategies. For example, Mali's pledge to increase the area covered by small-scale irrigation schemes is currently being implemented via the National Program of Small-Scale Irrigation (PNIP). Covering the period 2012–21, this aims to ensure reliable access to water for rural smallholders by installing small-scale irrigation infrastructure, mostly in the form of small dams. This could lift rice yields to as much as 6 tonnes/hectare and benefit up to 3 million people.[105]

Opportunities for regional investment

As regional initiatives such as 2iS and the PARIIS project make clear, improving irrigation in West Africa will involve a range of interventions. Particularly promising areas for investment include the following:

— **Rehabilitation of existing irrigation infrastructure.** According to 2iS, while the region hosts a number of large irrigation schemes that are not functioning to their full potential, just 15% of the money currently earmarked for irrigation in national investment portfolios is destined for rehabilitation.[106] This points to a gap in funding that investors could help to fill, for example by supporting the training of farmers in maintaining and repairing tertiary irrigation channels.

— **Expansion of small-scale irrigation.** 2iS identifies five types of irrigation projects suited to West Africa that need to be developed to help the region to fulfil its agricultural potential. Small-scale irrigation systems (both private and community-managed) can be scaled up easily and can yield very significant economic benefits.[107] In Mali, investment in small-scale private irrigation schemes is needed, and the government has identified this as a key priority for expansion.[108]

— **Adoption of climate-smart irrigation models.** In a water-scarce region like West Africa — and particularly in Sahelian countries such as Senegal, Mali and northern Nigeria — any irrigation projects must be as water-efficient as possible. Drip irrigation is well-suited to small-scale systems and can help to optimise water use, reducing waste and evaporation while increasing yields.[109] Mali is pioneering a model of what private-public collaboration could look like: SOPROTRILAD, one of the biggest rice processing and production companies in Mali, is working with Dexis Consulting and Netafim, one of the largest smart irrigation companies in the world, to develop drip irrigation in Mali. The partnership is aligned with the Malian Government's National Agricultural Investment Plan (NAIP). If successful, drip irrigation could boost rice yields by 40-50%, allow for year-round agricultural production, increase farmers' income and promote food resilience.[110]

3
THE BUSINESS CASE FOR SUSTAINABLE RICE

3.0
THE BUSINESS CASE FOR SUSTAINABLE RICE

A sustainable rice sector is defined as one that is affordable, improves the livelihoods of rice producers and significantly reduces the environmental impact of rice production.

A number of technical innovations have been, or are being, developed to address the sector's sustainability challenges. A range of platforms, notably the Sustainable Rice Platform (SRP), are helping to mainstream these practices globally.

Doing so would help to close the yield gap, improve global food security and reduce poverty; drive climate adaptation to prevent future crop losses, yield declines, pest outbreaks and price spikes; and reduce the sector's contribution to GHG emissions.

THE COMPETITIVE AFRICAN RICE INITIATIVE (CARI) PROJECT HAS MORE THAN DOUBLED YIELDS AND LED TO INCOME GAINS OF NEARLY 300%

3.1
THE ECONOMICS OF SUSTAINABLE RICE

Sustainable rice production translates into higher farmer incomes in three ways:

1
Greater productivity and lower input costs boost production and incomes. In Cambodia, shifting to sustainable rice cultivation has increased rice yields by 20% and farmers' incomes by 25%.[111] In Sub-Saharan Africa, where yields are far below potential, good agricultural practices such as more efficient use of water and fertiliser has also led to such increases. For example, support from the Competitive African Rice Initiative (CARI) has more than doubled yields and lifted incomes by nearly 300%.[112] In Vietnam, integrated pest management has cut input costs and increased smallholders' profits by $190 per hectare.[113] Meanwhile, in Bangladesh and Vietnam, Alternate Wetting and Drying (AWD) has increased yields and reduced irrigation costs, lifting smallholder incomes by $100–$400 per hectare.[114]

2
Sustainably produced rice is more resistant to stresses, limiting crop losses. There is also evidence that practices such as integrated pest management and precision use of inputs can cut the risk of catastrophic crop losses due to stresses such as extreme weather and pest and disease outbreaks. In Vietnam, switching to low carbon production has made rice more resilient to storms, helping lift income by up to 60%.[115]

3
Increased quality and traceability translate into a higher market price for sustainable rice. In Vietnam, rice firm Loc Troi has identified a small price premium for SRP-produced rice which, together with lower inputs, translates into an 18% increase in farmers' profits per hectare.[116] Market research has shown that Vietnamese consumers are willing to pay between 9% and 33% more for certified sustainable rice.[117]

HIGHER FARMER INCOMES, BETTER LIVELIHOODS

Given that most rice smallholders are poor, extra income generated through rice farming first and foremost increases household spending. For example, in Myanmar and Indonesia, better agricultural practices have helped increase farmers' incomes by an average of just over $100, which they have spent on household expenses such as social and religious activities, education, healthcare, and food.[118]

That said, evidence from countries as diverse as Benin and Cambodia shows that when farmers' incomes have risen due to better access to markets, higher yields and reduced inputs, at least some of them spend part of the extra money on loans to improve their production capacities.[119] [120]

Increasing rice yields through good agricultural practices has reduced the number of farmers defaulting on loans and lifted the funding available for rice farmers. In Selingue (Mali), organising farmers into collectives and introducing good agricultural practices raised rice production, which in turn cut the loan default rate to just 5%.[121]

Meanwhile, in Senegal, USAID's Naatal Mbay (Flourishing Agriculture) project has stabilised rice prices and led farmers to benefit from economies of scale due to aggregation, with rice farming becoming more profitable as a result.

The percentage of farmers defaulting on loans has fallen from 20% to 5% — and this in turn has made lenders more willing to lend money to rice farmers. As a result, the amount of credit available for rice farmers has tripled, from $6.9 million to $20 million.[122]

3.2
SPOTLIGHT ON SUSTAINABLE PRACTICES

Practices

Alternate Wetting and Drying (AWD). This practice, under which rice fields are alternately flooded and kept dry, can help farmers reduce their water use by 500 litres per kilogram of rice and cut methane emissions by up to 50% — without reducing yields.[123] In Bangladesh and Vietnam, AWD increased smallholder incomes by $100-$400 per hectare due to higher yields and lower irrigation costs.[124] Additional benefits of AWD may include reduced exposure to fungal disease and improved soil condition.[125]

Improved rice straw management. Rather than burning rice straw and other residues, or leaving them to decompose in the field, if farmers remove these from the field, the straw can be processed and used for purposes such as animal fodder, fertiliser, and to produce bioenergy and building materials, reducing emissions whilst also generating an additional source of income for farmers.[126] Farmers can reduce methane emissions by 70% through improved rice straw management, but capacity-building and market incentives are needed to encourage widespread adoption of the practice.[127]

Integrated pest management. On average, rice farmers lose 37% of their crop to diseases and pests.[128] Integrated pest management techniques such as using pheromone traps and sticky traps to detect pest outbreaks early, and ensuring good weed and water management, enable farmers to reduce risks from pest outbreaks due to climate change.[129] In Vietnam, implementing integrated pest management lowered input costs, which increased smallholders' profits by $190 per hectare.[130]

Site-Specific Nutrient Management (SSNM). SSNM allows smallholders to increase their productivity and income by applying fertiliser in a particular place at a specific time in precise amounts.[131] In some countries, software is being developed to help farmers to compute the best nutrient management strategy for their location. In Vietnam's Red River Delta, adoption of SSNM increased farmers' profits by $150 per hectare, mostly as a result of higher yields.[132]

Laser land levelling. By using laser-guided technology to level fields, farmers can minimise water run-off and fertiliser use and raise rice yields by up to 25%.[133] In the Indian state of Haryana, levelling 500,000 hectares helped to save 1,000,000,000m^3 of water.[134]

Systems

System of Rice Intensification (SRI). Originating in Madagascar in the 1980s, SRI sustainably increases irrigated rice productivity through principles such as reduced plant density, improved soil conditions through enrichment with organic matter, and reduced and controlled water application.[135] SRI has been deployed in more than 50 countries and has increased yields per hectare by 21%–105% (average 52%) as well as significantly reducing input requirements and production costs.[136]

Rice-fish systems. Rice-fish farming is an ancient technique practiced in many countries, which involves farming aquatic species (including finfish, crustaceans and molluscs) in rice paddies. There is growing interest in reviving and expanding these systems, which lift rice yields, household incomes and nutrition.[137] Fish reduce biotic threats to rice by eating weeds and insects that otherwise damage rice crops, while fish manure fertilises rice plants and reduces the need to apply fertiliser. Properly implemented, rice-fish systems can double rice yields.[138]

Infrastructure, inputs & technologies

C_4 and stress-resistant rice. Through genetic engineering, scientists are trying to improve rice's capacity for photosynthesis from a 'C_3' to a 'C_4' crop, like maize. This could raise photosynthetic efficiency by 50%, double water efficiency, increase nitrogen-use efficiency[139] and lift yields by 30%–50%.[140] C_4 is seen by experts as one of the most plausible innovations for enhancing crop yield and resilience in the face of reduced land area, unpredictable water supplies and climate change. IRRI says there is great potential to develop rice strains that are tolerant to abiotic stresses including drought, salinity, submergence and high temperatures.[141]

Expansion of irrigated area with smart irrigation. In West Africa's Sahel region, irrigated rice cultivation is currently practiced on 440,000 hectares. However, around 3 million hectares along the Senegal, Niger, Black Volta, Chari and Logone rivers could be suitable for irrigation.[142] In areas where irrigated rice is being grown, water management skills and the use of smart irrigation technologies are very low, undermining rice productivity. By expanding efficient irrigation infrastructure and improving water management, rice production in the region could be significantly increased.

Post-harvest technologies. In Southeast Asia and Africa, post-harvest losses can be as high as 30% due to spillage, losses to pests, inappropriate post-harvest management, delays in the post-harvest chain and outdated post-harvest equipment.[143] Improved post-harvest management — including drying and storage — can help reduce post-harvest losses and increase grain quality, increasing farmers' income.

3.3
A PERFORMANCE FRAMEWORK TO MEASURE SUSTAINABLE RICE

The Sustainable Rice Platform (SRP) is a global multi-stakeholder alliance established in 2011, which has produced a global voluntary standard for sustainable rice production, linked with a set of Performance Indicators to measure and monitor impact. SRP is co-convened by UN Environment and the International Rice Research Institute (IRRI).

With over 100 institutional members the alliance provides private, non-profit and public actors in the global rice sector with sustainable production standards and outreach mechanisms that contribute to increasing the global supply of affordable rice, improving rice producers' livelihoods and reducing the environmental impact of rice production.

Now in its second revision, the SRP Standard sets out 41 requirements across themes, and 12 performance indicators, which together provide a comprehensive and practical compliance and monitoring mechanism specific to the various aspects of rice cultivation.

This performance framework is an important building block for the design of innovative finance partnerships and products that can push more capital towards a more sustainable value chain with measurable and verified impact.

SRP seeks to improve the sector's environmental footprint in key areas such as water use and nutrient-use efficiency, GHG emissions, and biodiversity protection.

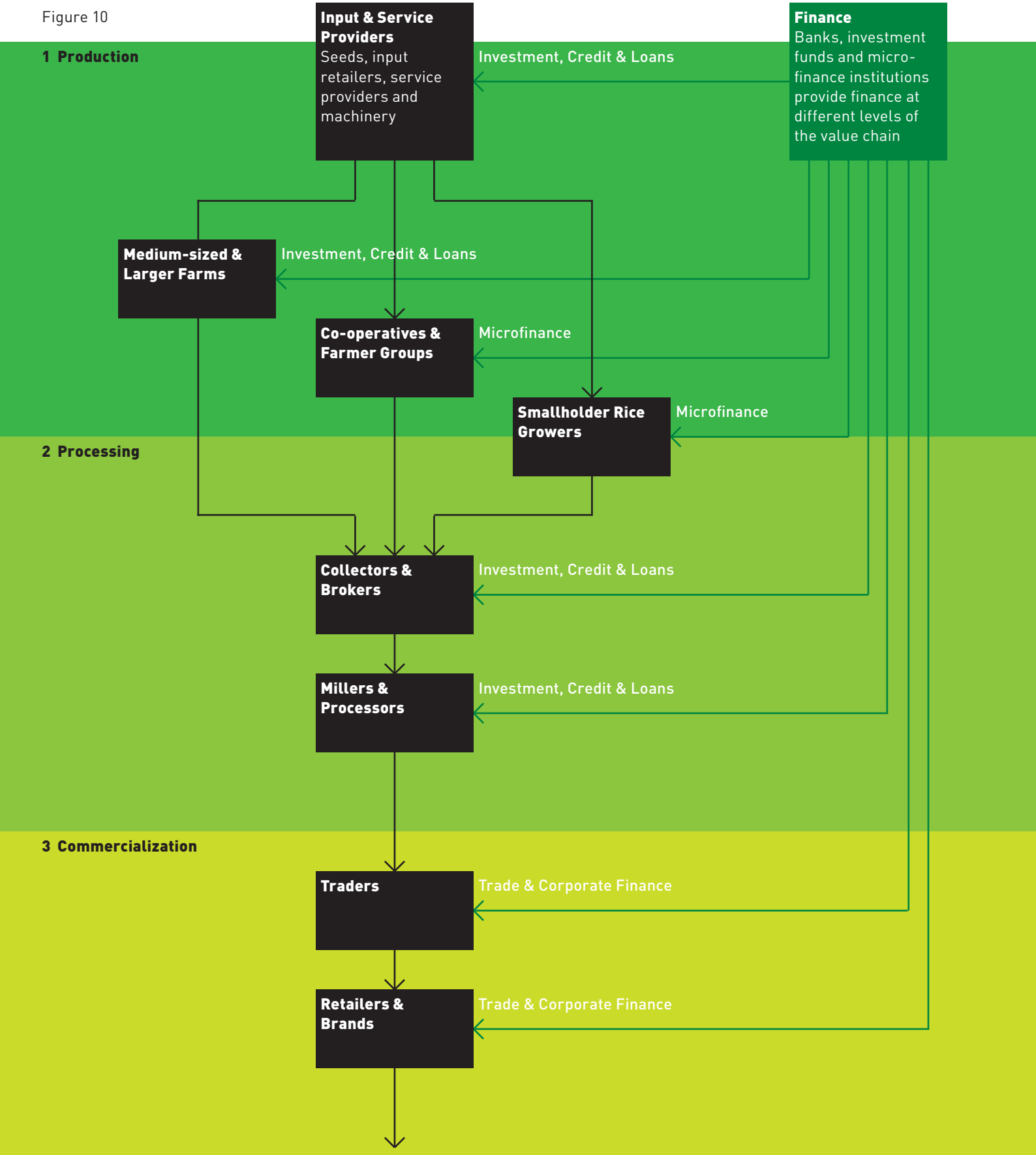
It focuses on social progress through workers' health and safety, abolishing child labour and empowering women. Finally, it is focused on the business case, by measuring profitability and productivity improvements from sustainable practices, which are fundamental to ensure livelihoods, improve food security, and influence farmers to change their behaviour.[144]

Figure 9
12 SRP Performance Indicators for Sustainable Rice Cultivation

SRP Performance Indicator	What is being measured?
Profitability: net income from rice	Farmers' net income increases from rice cultivation
Labour productivity	Amount of rice produced per unit of labour
Yield productivity	Increases in yields with same level of inputs
Water productivity	Efficiency of irrigation and quality of runoff water
Nutrient-use efficiency — N	Efficiency of nitrogen-based fertilisers
Nutrient-use efficiency — P	Efficiency of phosphorous-based fertilisers
Biodiversity	Enhancement of biodiversity in rice plantations
GHG emissions	Reduction of methane and nitrous oxide emissions
Food safety	Absence of toxic residues (heavy metals, pesticide residues)
Health and safety	Worker safety and management of pesticides
Child labour & youth engagement	Absence of child labour and children are in full-time education
Women's empowerment	Women's access to finance, training and decision-making

3.4
THE VALUE CHAIN

Figure 10



Value Chain Actors	Impact Opportunities	Financing Solutions
Producers At the production level, the rice value chain is highly fragmented—especially in Asia and Sub-Saharan Africa—comprising 144 million low-income smallholder farmers who operate plots of land smaller than 1 hectare and are involved in the cultivation, harvesting, drying and storing of paddy rice.[145]	**Smallholder access to finance** Service providers can act as a point of finance for smallholder farmers providing credit for goods. Facilitating farmers' access to affordable, higher-quality inputs such as seeds, supporting mechanised harvesting and drying processes, facilitating access to technologies such as precision irrigation could raise yields by nearly 400 kg/hectare, raise farmers' profits, and reduce methane emissions from the sector by 70%.	**Collateral & guarantees** Becoming a member of a cooperative can improve a farmer's access to group loans and digital platforms and can create conditions for the delivery of pooled financial products and bundled services. Collaboration is needed to develop financial models that can accept a wider range of forms of loan collateral, such as livestock and farm machinery rather than land ownership titles in areas where farmers lack secure land tenure. Guarantees and partial subsidies can incentivise financial providers to offer farmers longer-term loans that allow them to invest in capital intensive assets such as farm machinery, or to make financial products affordable to smallholders.[152]
Processors Millers and processors are a key point of aggregation for farm produce. They range from small village mills to larger regional bases and can act as marketing centres, where buyers and sellers meet and trade.[146] Larger mills can be owned and operated by rice traders or retailing-manufacturers that integrate vertically. Upstream, processors play a crucial aggregator role and can supply finance such as loans to farmers.[147]	**Processors as key enablers** Promoting investment in the milling sector and replacing obsolete processing units could significantly reduce postharvest losses, which are frequently as high as 30%.[148] In the case of Cambodia, upgrading the processing sector led to a rapid rise in production and exports of milled rice between 2011 and 2015.[149] Meanwhile, more formal relationships between smallholders and processors can help create a virtuous cycle in which value chain actors have the reliable source of income needed to invest in upgrading their operations, increasing yields and incomes.[150]	**Warehouse receipts** In a warehouse receipts system, producers deliver their produce to a warehouse and are presented with a receipt that can be used as collateral for obtaining credit from banks or micro-finance institutions.[153] By providing farmers with a viable form of collateral, this mitigates the risks involved in lending to them and allows them to access loans at lower interest rates. In India, where this form of financing is quite widespread, interest rates for loans where warehouse receipts are used as collateral are 1.5–2% lower than the usual rate for farmers.[154]
Traders Rice traders are involved across all levels of the rice value chain. They are active in domestic and farm gate procurement, as well as processing, export/import, wholesale and retail distribution.[151] They range from large multinationals to smaller regional companies. Retailers range from 'open-sack' market sellers, to local and regional supermarkets chains and large international buyers from global brands.	**Sustainable sourcing contracts** Developing sourcing strategies and contracting mechanisms to buy sustainable rice from farmer cooperatives to ensure quality and traceability; and developing brand value from sustainable rice linked to a lower environmental footprint and fairer trade, to position sustainable rice in local, regional and global markets.	**Offtake agreements** Agriculture is inherently risky. A series of contractual arrangements along the value chain can help lower risks and increase access to capital. For example, offtake agreements — by which a company makes a promise to buy a certain volume of a crop at a fixed price at a certain date in the future — are a useful risk mitigation tool in smallholder farming.[155] This can create three-way relationships between farmers, processors and banks where banks provide credit to farmers, farmers sell their produce on a forward contract to processors, and processors then repay the loan to the banks.[156]

Case Studies Across Agri-Value Chains

1 Production

RABOBANK
ETHIOPIA

Rabobank Foundation and Rabobank Rural Fund set up a $2.25 million credit guarantee scheme to enable banks to use guarantees as an alternative to traditional collateral for coffee growers in Ethiopia. A risk-sharing agreement between the Rabobank Foundation and CFC covered half of any losses incurred through lending to farmers. Rabobank International Advisory Services also provided technical assistance to banks to train cooperatives on financial literacy and corporate governance.

The guarantee scheme provided working capital loans amounting to over $700,000 to 11 cooperatives, all of which received loans directly from the bank for the first time in their history. As this phase was closing, the bank reported a 98% loan recovery rate.[157]

2 Processing

HDFC BANK
INDIA

HDFC Bank, one of India's leading banks, offers a warehouse receipt loan facility where farmers and small traders can receive loans starting from $2,250 against storage of some 50 commodities in one of 3,500 approved private or state warehouses country wide. Warehouse receipt financing—the use of securely stored goods as loan collateral—helps small farmers to preserve their harvest and hold off selling until market prices are higher, while also mitigating the risk to financial institutions. HDFC finances 65–75% of the receipt value and offers moderate interest rates of 8-10%.

Farmers receive the loan as soon as they deliver the warehouse receipt. Small farmers can participate by pooling their resources through a representative farmer. Profits for farmers range between 35% and 40%, while HDFC benefits from lower risks.[158]

3 Commercialization

MARS FOOD
GLOBAL

Mars Food announced that all the rice sold under its brand UNCLE BEN'S®, the world's largest rice brand, will be sourced from farmers who are working towards the Sustainable Rice Platform (SRP) standard by 2020 — a first in the global rice industry. It has already achieved 97%. Mars Food is investing to raise living incomes of rice farmers and implement water stewardship programs. It covers 9 countries with 15 partner organizations like IFC, GIZ and Oxfam across Asia, Europe and the USA.

In Pakistan and India, Mars Food works with 2,000 basmati rice farmers to help them adopt sustainable practices. It has seen a 17% increase in yield, a 30% increase in farmer income, and a 30% reduction in water use from farmers adopting more sustainable growing methods.[159]

4
BLUEPRINTS TO SCALE FINANCE FOR SUSTAINABLE RICE

4.1 ADDRESSING KEY FINANCING GAPS TO SCALING SUSTAINABLE RICE

A shift to more sustainable and climate-smart production methods in agriculture requires upfront investment, and a transition from existing production systems.[160]

There are considerable barriers to scaling private sector finance for agriculture: they include the high-risk profile of the agriculture sector, the seasonal nature of farming, the specialisation needed to assess investment opportunities, and the low appetite to lend to smallholder farmers due to limited or no collateral and established credit histories. These challenges are particularly prevalent in the rice sector.

A large range of innovative finance efforts exist in various commodities to make smallholder farmers more bankable by overcoming farm-level fragmentation through aggregation, and by managing production risks by pairing finance with technical assistance for farmers.

Creating stronger value chains that continuously build the capacity of smallholder farmers in a way that is linked to market access and off-takers can make finance innovations more attractive by providing a more predictable and consistent flow of income along the value chain—ultimately ensuring that increased access reaches farmers to help develop sustainable practices.

The Sustainable Rice Platform (SRP) provides an agreed standard and a foundation of metrics upon which finance innovations can be developed.
In this section, we focus on possible blueprints to improve the flow of finance to sustainable practices in the rice value chain based on public-private collaboration.

Barriers to Finance	**Barrier 1** **The absence of a financial infrastructure to service millions of rice smallholders who lack access to services**	**Barrier 2** **The upfront investment needed for companies, suppliers and farmers to switch to climate-smart production methods**	**Barrier 3** **The lack of public financing for governments to attract private sector investment through blended finance instruments**
Blueprints for Action	**Blueprint 1** **Create a digital finance platform for financing to reach smallholder farmers**	**Blueprint 2** **Issue a 'rice bond' to finance sustainable rice value chains**	**Blueprint 3** **Leverage international climate finance to attract private sector investment for climate-smart rice production**

BLUEPRINT 1
CREATE A DIGITAL FINANCE PLATFORM FOR FINANCING TO REACH SMALLHOLDER FARMERS

Enabling Environment

1
Digital finance solutions can increase smallholder productivity and raise farmer incomes.

By 2030, GSMA estimates that 275–350 million farmers will gain access to mobile-based service delivery for agricultural products and services. This can enable $394 billion in cash payments by agricultural buyers to be shifted to mobile delivery channels.[161] Bundling digital payments from bulk buyers with access to mobile micro-credit, insurance products such as weather-index crop insurance and savings accounts could lift smallholder farm productivity by 30–60%.[162] A new large-scale strategic partnership between Mastercard's Farmers Network (MFN) and Rabobank aims to connect one million farmers across East Africa and South Asia to potential buyers, providing them with access to mobile payment tools, and building a digital transaction record that can be used to access formal credit from financial institutions.[163]

The Rice Mobile Finance (RiMFin) programme in Ghana is a partnership between telecoms groups, agribusinesses, and public agencies to convert rice buyers' sourcing and payment systems from cash to mobile and turn farmer's phones into e-wallets. In Asia, the Grow Asia Digital Directory documents 19 digital solutions focused on rice such as FarmForce, Cropital, and Agribuddy, six of which currently provide access to financial products such as value chain financing, weather-based micro-insurance, and crowdfunded capital.[164] Some of these platforms can be expanded — for example, the Swiss Agency for Development and Co-operation (SDC) has supported a platform to facilitate bundled financial services for smallholders across Uganda, Indonesia and Zimbabwe, which a quarter of a million farmers are using.[165]

2
There are 400 digital solutions for agriculture in Africa alone and there are promising signs that the sector is maturing.

The total addressable market revenue in Africa alone for agriculture digital technology solutions is an estimated $2.5 billion. The sector grew at about 40% per year between 2016 and 2019, with nearly 60% of the solutions having launched in the last three years. Around 33 million smallholder farmers in Sub-Saharan Africa are now registered with a digital solution provider and as many as 200 million are expected to register by 2030.

A small but growing number of providers operate profitable business models — digital finance service providers in Africa report average revenues of $4 per farmer.[166] The digitization momentum is further accelerating as 'big tech' companies such as IBM, Google, Alibaba, and Microsoft develop large-scale holistic digital platforms for the sector — in 2019, IBM and Yara International announced plans to build the world's largest digital farming platform, covering 7% of all arable land worldwide including millions of smallholder farms.[167] Digital agricultural crowdfunding platforms are also growing fast — for example, FarmCrowdy in Nigeria connects small scale farmers with sponsors. Both farmers and sponsors receive a percentage of the profits on harvest.

Despite the significant growth of digital finance for agriculture, most solutions are nascent and the overall sector remains fragmented. Improving coordination across solutions, increasing use by farmers, and demonstrating impact on farm-level practice is an important next frontier for the sector.

3
Better digital infrastructure and data governance can reduce fragmentation and promote interoperability but regulatory hurdles remain a constraint.

New initiatives such as the All Africa Digital Economy Moonshot, an effort by the African Union and the World Bank, to digitally connect every individual, business and government in Africa by 2030, are laying the foundations for robust digital economies in rice-producing countries.

The Digital Financial Services (DFS) Working Group of the Alliance for Financial Inclusion (AFI), a global network of policymakers, provides a common framework to measure how different digital finance platforms work together and core indicators that countries can use to assess financial inclusion—these can help to integrate existing digital finance solutions in line with national objectives for smallholders.[168] GSMA finds that while data sharing among digital finance providers generally remains limited, there is a growing trend toward data sharing partnerships and service integration in the sector — for instance, Twiga Foods and Tulaa, Kenya-based agriculture e-commerce platforms linking farmers to markets, share their data to offer extra services to farmers such as loans and credit inputs.[169]

Despite these developments, countries' restrictive policy and regulatory environments present a critical constraint to the expansion of digital finance services and can stifle investment in product development. GSMA finds that enabling regulation is an important predictor of success in digital finance services and provides regulators with specific recommendations where targeted policy interventions can be employed to enable digital finance uptake.[170]

BLUEPRINT 1

CREATE A DIGITAL FINANCE PLATFORM FOR FINANCING TO REACH SMALLHOLDER FARMERS

4

Digital finance platforms can enable smallholders to access government credit and insurance programmes.

Large-scale government digital financing initiatives are also emerging, such as Indonesia's digital platform to distribute state subsidised loans and farm insurance for rice farmers projected to result in an increase of rice outputs by at least 20%.[171] Governments are critical to scaling finance, for example by helping to de-risk private sector capital through guarantees, or part-subsidising insurance products to support their adoption by smallholders. Insurance provider AXA's pilot programme in Indonesia gives rice farmers insurance to protect them against weather-related crop losses, with the government paying up to 80% of the premium cost. The pilot was successful, and the project is being scaled up.[172]

These initiatives can be further supported by new global funds such as the GSMA Innovation Fund for Digitisation of Agricultural Value Chains, and at a multilateral level by UN-led strategies with member states, such as a programme led by the United Nations Capital Development Fund (UNCDF): 'Leaving No One Behind in the Digital Era'.[173]

Action Recommendations

Recommendation 1

SRP to convene a Digital Rice Finance Task Force involving agribusinesses, banks, and technology providers to define the scope and services of an integrated digital finance platform for sustainable rice.

The task force would aim to understand the applicability of existing digital solutions, and define the scope, requirements, and technical specifications for how these models can be integrated more effectively and tailored to the regulatory context of countries or regions. The task force would define key considerations and criteria, such as data collection and verification; identify ways to enable data sharing (e.g., common farmer ID) and interoperability via API across digital platforms (public as well as proprietary operated by agribusinesses) and consider country-level parameters around enabling policies and regulations, mobile connectivity and penetration, and availability of financial services.

For example, Olam International's Farmer Information System (OFIS) is operational in the rice sector in Thailand and Vietnam and aims to expand to 100,000 smallholders globally by 2020. In markets where Olam sources from local agents and co-operatives, it deploys OFIS in combination with its Olam Traceability and Digital Warehouse solutions to achieve end-to-end traceability of the entire supply chain. The information system supports links to third-party providers to bundle financial services, inputs, and technical support to smallholders.[174]

Recommendation 2

Develop an integrated digital finance pilot which demonstrates how technology, finance, government and value chain actors can partner to enhance finance access to smallholders working towards the SRP standard.

Building on the work of various SRP partners in a focus country offers a focal point to develop and pilot a digital finance platform that integrates value chains and projects. For example, in Thailand, 5,000-10,000 smallholder farmers participate in sustainable rice production at different sites, with a plan to scale to 150,000 farmers in the next five years.

This provides a basis for a technology or digital payments company committed to sustainable agriculture, such as Mastercard, to partner with SRP and member companies on a Thai platform pilot. A partnership between SRP, its members and a company like Mastercard, would allow the creation of a series of finance-sector partnerships to deliver bundled financial services for smallholders, ranging from local banks to insurance companies. The Thai government has approved a $682 million national rice insurance scheme for over 4 million farmers launched by the Thai General Insurance Association and reinsurer SwissRe.[175] It is part of a series of services that could be bundled together to benefit SRP-implementing smallholders.

A digital finance platform would also enable faster, cheaper and more transparent payout of crop insurance to smallholders, for example by integrating the satellite monitoring technology used by SwissRe and the RIICE partnership to create a faster trigger of crop insurance payments based on extreme weather events.[176]

BLUEPRINT 1
CREATE A DIGITAL FINANCE PLATFORM FOR FINANCING TO REACH SMALLHOLDER FARMERS

CASE STUDY
MASTERCARD FARMERS NETWORK (MFN)

Launched in 2015 by the Mastercard Lab for Financial Inclusion, MFN gives farmers a unique ID and helps to connect them with potential buyers, links their businesses to payment systems, and enables them to build a digital transaction record they can use to access formal credit from banks and other financial institutions.

The platform enables third party financial institutions to issue credit and insurance products and process payments to farmers and others in the value chain. Already operational in East Africa, MFN recently expanded its operations to millions of smallholders across Uganda through a public-private partnership with the International Center for Tropical Agriculture (CIAT) and the United States African Development Foundation (USADF).

In late 2018 MFN partnered with the government of Andhra Pradesh in India to expand the platform's services to over 1 million small and medium size farmers, working with a large commodity buyer and producer co-operatives.[177]

BLUEPRINT 2
ISSUE A 'RICE BOND' TO FINANCE SUSTAINABLE VALUE CHAINS

Enabling Environment

1
2020 is expected to be a milestone year for the development of green bonds for agriculture.

Globally, the market for green bonds is expected to grow from $167 billion to a record $180 billion in 2019. However, in 2017, agriculture and forestry comprised only 1% of the overall climate-aligned bond universe and in 2018 it did not grow much.[178] The Green Bond Principles — the main voluntary guidelines for issuing green bonds developed by the International Capital Markets Association, consider sustainable agriculture and climate-smart farm inputs (e.g. drip irrigation investments) as eligible for the use of a bond's proceeds.[179]

To catalyse the growth of green bond issuance in agriculture, the Climate Bonds Initiative (CBI), a standards-setting body, is developing the taxonomy to guide issuers, banks and investors in developing agriculture-related green bonds. A first draft will be published in Q4 2019, creating expectations the market could take off in 2020.[180] The World Business Council for Sustainable Development (WBCSD) and the Task Force on Climate-related Financial Disclosure are organising forums to clarify how agribusinesses should disclose climate risks to investors, providing additional momentum.[181]

2
Experimentation with bond-like debt instruments is providing a creative way to attract the private sector to finance development.

For example, in 2017 the International Committee of the Red Cross (ICRC) issued the world's first 'Humanitarian Impact Bond' to support the financing of aid in conflict-hit countries — it is actually a private investment placement, rather than a bond.

The initial payments by impact investors identified by co-sponsor Bank Lombard Odier enable the ICRC to run the activities at each rehabilitation centre and hence expand the ICRC's Physical Rehabilitation Programme (PRP). At the end of the 5th year, 'Outcome Funders' — the governments of Belgium, Switzerland, Italy, the UK and "La Caixa" Foundation — will pay the ICRC according to the results achieved. These funds will in turn be used to pay back the social investors partially, in full or with an additional return, depending on how efficient the ICRC's new centres are.[182]

3
Some rice-producing countries are encouraging sustainable finance by domestic banks.

Financial regulators and banking associations from 34 emerging markets representing close to $43 trillion in assets have convened as a Sustainable Banking Network (SBN). Over the past five years, they have introduced sustainable finance policies and principles to build capacity and motivate changes in their banking sectors. They include several rice-producing countries such as Nigeria, Vietnam, Bangladesh and Thailand. For example, the Central Bank in Bangladesh has set up an exclusive refinancing window to encourage green finance initiatives and has issued a requirement that all banks devote at least 5% of their portfolios in green finance to pre-defined sectors including agriculture.

These local ecosystems enable other finance vehicles — such as the Council on Smallholder Agriculture Finance (CSAF) — to provide financial incentives that can raise the risk appetite of domestic lenders to invest in more inclusive agricultural value chains.[183]

4
Global banks are signalling innovative sustainable finance for agriculture.

Rabobank and UN Environment have launched the AGRI3 Fund, designed to unlock $1 billion in finance towards sustainable agriculture by bridging the gap between the needs of farmers and the limitations of banks. The fund provides de-risking financial instruments, tailored technical assistance and seeks to catalyse access to capital for farmers through structured programs involving commercial banks, agribusiness companies and local governments.[184]

ING has developed a 'sustainability improvement loan' where the interest rate is linked to a borrower's sustainability performance, rated by a third party.[185] In 2018, Olam International, one of the leading companies advancing sustainable rice and a member of SRP and Chair of WBCSD, secured a three-year sustainability-linked revolving credit facility for $500 million — Asia's first sustainability-linked club loan issued by 15 participating banks, based on achieving sustainability targets.[186]

BNP Paribas and ADM Capital have linked with UN Environment and the World Agroforestry Centre to create the Tropical Landscapes Financing Facility (TLFF) in Indonesia. The partnership aims to bring long-term finance to projects and companies that advance sustainable agriculture and rural livelihoods in Indonesia. In 2018, BNP Paribas arranged a $95 million multi-tranche sustainability-labelled series of project bonds issued by a special purpose vehicle to fund PT Royal Lestari Utama (RLU), a joint venture between France's Michelin and Indonesia's Barito Pacific Group to finance a sustainable rubber plantation on heavily degraded lands.[187]

BLUEPRINT 2

ISSUE A 'RICE BOND' TO FINANCE SUSTAINABLE VALUE CHAINS

Action Recommendations

Recommendation 1

Integrate SRP performance indicators into the Climate Bonds Initiative's taxonomy for green bonds in agriculture.

In 2020, the Climate Bonds Initiative's Working Group on Agriculture will release an initial taxonomy for the agriculture sector, which can directly integrate the SRP performance indicators to define a globally-accepted taxonomy framework for rice bonds. This will establish the SRP as the framework for companies, banks and investors to use as a common basis for bond design, issuance and reporting.

Recommendation 2

Convene a Working Group involving banks and agri-businesses to define the parameters of a 'rice bond'.

This can be co-convened by SRP and the World Business Council for Sustainable Development (WBCSD) through its work on climate-smart agriculture with companies and banks. The working group would define important parameters for the further specification of this instrument. These include: identifying companies along the value chain that are suitable for issuance (including large-scale growers, millers and processors, and service providers); ensuring that the options make more financing available to smallholder farmers, who are ultimately most in need, by for example considering the integration of smallholder finance funds; and the integration of verification and insurance.

Recommendation 3

A global rice processor, trader, retailer or brand that has off-take agreements with sustainable rice farmers and an integrated value chain to consider issuing a 'rice bond'.

Tight supply chains linking farmers, suppliers and buyers of sustainable rice with existing contractual relationships and trust will be easier starting points for a rice bond given existing relationships (e.g. millers can provide pre-financing to farmers before the season starts). Global companies such as Mars Food, Phoenix, Olam, Galaxy, or Ebro, which are export oriented and off-takers of sustainable rice, can provide the necessary trust and guarantees for millers to pre-finance farmers based on agreed future purchases. This creates the conditions for a rice bond to enable global retailers to finance the growth of their sustainable rice sourcing process.

Recommendation 4

Develop a 'rice bond' that uses the purchasing power of the World Food Programme (WFP) to drive global demand for sustainable rice, enabling upfront investments in climate-smart production.

In 2018 WFP delivered a total of 3.9 million metric tonnes of food around the world. WFP's food procurement increased 64% between 2014 and 2018, driven by large-scale emergencies in Syria, Yemen and South Sudan.[188] Rice makes up almost 10% of the total food procurement of WFP. From 2017 to 2018 rice volumes purchased by WFP have gone up significantly, by 34%.[189]

International agencies are increasingly using bond-like debt instruments to enable the private sector to finance development. Such a 'rice bond' could help WFP to prioritise the sustainable procurement of rice, while focusing on maintaining food security outcomes (i.e. the same level of quantities purchased) that are vital to WFP's mission in humanitarian contexts. In order to do this, such a 'rice bond' will need to develop innovative roles for international donors, which could help bridge the differential in any added costs for purchasing sustainable rice.

By providing guarantees and outcome-driven financing, international donors would help to maintain WFP's mission on food security, while at the same time incentivise the global demand for sustainable rice and climate-smart agriculture transition. On the production side, initial calculations show that such a bond could make upfront financing available to help 75,000 farmers in Southeast Asia to invest in a switch to sustainable rice production, with the goal to deliver 150,000 metric tons of sustainable rice each year to WFP. Further exploring this potential mechanism will require the design of a focused process of dialogue and prototyping involving WFP, SRP, donors and innovative financing agencies such as UNCDF.

BLUEPRINT 2
ISSUE A 'RICE BOND' TO FINANCE SUSTAINABLE VALUE CHAINS

CASE STUDY

THE RESPONSIBLE COMMODITIES FACILITY IN BRAZIL: A GREEN BOND TO FINANCE RESPONSIBLE SOY

Launched in July 2019 at the London Stock Exchange, the Responsible Commodities Facility will provide low-interest credit lines to 1,000 medium-sized soy farmers who commit to using degraded lands and avoiding deforestation, re-directing soy expansion to degraded cattle pastures in the Brazilian Cerrado region.

The facility is expected to provide $1 billion over the next four years to fund the production of more than 180 million tonnes of responsible soy and corn, worth around $43 billion over the next decade. The financing for RCF will be raised by issuing investment grade-rated green bonds through a special purpose vehicle aimed at institutional investors. Responsible soy will be sold on an exchange that links producers with international buyers interested in sustainable sourcing. The first $300 million bond issuance is planned for the planting season of 2020.

The investment will contribute to national targets of agricultural expansion into currently underused land. Over the same period, the facility aims to protect or restore 1.5 million hectares of natural habitat in Brazil's Cerrado, cutting carbon dioxide emissions by around 250 million tonnes.[190]

BLUEPRINT 3
LEVERAGE INTERNATIONAL CLIMATE FINANCE TO ATTRACT PRIVATE SECTOR INVESTMENT FOR CLIMATE-SMART RICE PRODUCTION

Enabling Environment

1
Public climate finance can help governments to unlock private investment in agriculture.

The United Nations' Food and Agriculture Organisation (FAO) says that international public climate finance can help address the constraints many developing countries face in attracting private investment towards agriculture.[191] Public climate finance by donors or multilateral funding, can support governments to roll out services such as rural credit ratings, crop insurance and value-chain finance [192] or support blended finance mechanisms that provide public guarantees to attract private sectors investors to transform agriculture sectors. Forty eight countries have committed to implement climate-smart agriculture measures in their rice sector in their NDCs to the Paris Agreement.[193]

If NDCs have a more strategic framework to finance climate-smart rice production, this may incentivize large producers that have not included rice in their NDCs (India, Indonesia, Pakistan, Philippines and Thailand) to do so. The development of carbon markets under Article 6 of the UN Framework Convention on Climate Climate (UNFCCC) also plays a key role in establishing mechanisms to generate and trade carbon credits between countries, with several rice growing countries in SE Asian countries expected to trade credits.[194] This viability is also being guided by the development of public-private partnerships and voluntary market mechanisms by the Natural Climate Solutions Alliance, hosted by WBCSD and World Economic Forum, with the role of rice GHG emissions featuring as a key area of the Sustainable Rice Landscapes Initiative (SRLI).

2
Sovereign green bonds can help governments raise capital to implement their NDCs.

Governments are issuing green bonds to finance infrastructure plans in line with the climate targets set out in their NDC in line with the Paris Agreement. Public pension funds and sovereign wealth funds in developing countries, as well as international investors, can be well placed to invest in such instruments given their mandate to invest in their country's development.

A sovereign green bond can help reduce the cost of capital for green projects by attracting new investors, and mobilise private capital towards climate resilient infrastructure. Sovereign green bond programmes can include financial incentives such as tax reliefs and subsidies to develop low-carbon assets to crowd-in private investments in priority sectors. Sub-sovereign issuers such as states and cities have pioneered green bond issuance in the public domain.[195] Developing countries are increasingly using this tool. For instance, Vietnam's green bond market — primarily comprising sovereign bonds— has had the highest growth rate in the world in the last five years, reaching an outstanding volume of 18% of GDP — the economy's second biggest capital funding source after banking credits.

3
Governments can attract private sector investment by using blended finance vehicles.

Blended finance uses public funding to de-risk the profile of investments in order to attract the private sector (e.g. providing part-subsidies, first-loss guarantees, etc. that change the risk-return profile for investors). Despite the growing use of these mechanisms by development finance institutions and donors, only 3% of blended finance globally focuses on agriculture.[196] Examples of blended finance instruments for agriculture include:

— **The Africa Agricultural Capital Fund (AACF).** Established in 2011, the $25 million fund invests capital from $250,000 to $2.5 million in small and medium-sized agricultural enterprises in East Africa, providing concessionary finance and loan guarantees that reduce the risk for lenders, making agribusiness companies that can provide opportunities to smallholder farmers more bankable. The Gates Foundation, Gatsby Foundation and Rockefeller Foundation provide $17 million in concessionary equity investment while J.P. Morgan provides $8 million in commercial debt that is 50% guaranteed by USAID. A technical assistance (TA) facility funded by USAID supports SMEs to use the financing effectively. The fund's social impact objective is to positively affect at least 250,000 smallholder farmers by increasing individual household income by a minimum of $80 per household per year.[197]

BLUEPRINT 3

LEVERAGE INTERNATIONAL CLIMATE FINANCE TO ATTRACT PRIVATE SECTOR INVESTMENT FOR CLIMATE-SMART RICE PRODUCTION

— **The BUILD Fund** is a partnership between the UN Capital Development Fund (UNCDF) and the impact fund manager Bamboo Capital to invest in SDG-positive enterprises in Least Developed Countries (LDCs). To mitigate risk, it is designed as a blended finance vehicle that tiers investors according to their risk appetite in three 'layers': a first-loss 'catalytic capital' ($8 million), which is used to attract a mezzanine tranche ($15 million), which in turn protects a senior tranche ($25 million) of investors. The investors targeted for the Fund include foundations, family offices, corporate social responsibility and strategic venture arms, development finance institutions, and UN member states. The Government of Luxembourg has committed $2 million towards the first loss tranche. Additionally, the BUILD Fund includes a technical assistance (TA) sidecar vehicle (the BUILD Enterprise Resource ("BUILDER") TA Facility), which provides pre- and post-investment technical support to companies that are set to, or have received, financing from the Fund.[198]

— **The West African Initiative for Climate-Smart Agriculture (WAICSA)**, a newly conceived vehicle targeted at smallholder farmer organizations and agribusinesses to promote the adoption of climate-smart agriculture practices. It is led by the Commission of the Economic Community of West African States (ECOWAS) and comprises a Financing Facility (80% of the fund) managed by the ECOWAS Bank for Investment and Development (EBID). This provides concessionary loans, guarantees, and equity investments directly to smallholder organizations or through local finance institutions based on climate-smart agriculture conditionality; a Technical Assistance Facility (20% of the fund) managed by the Regional Agency for Agriculture and Food (RAAF) and funded through grants from the 15 ECOWAS Member States and donors such as USAID, the European Union, and SDC. ECOWAS public resources comprise the 'first-loss' tranche (22% of the total), which bear the highest risk and are designed to attract funds from development finance institutions, impact investors, and commercial investors. WAICSA projects will launch in 2020 in six ECOWAS Member States with plans to expand to all 15 in coming years.[199]

4

Multilateral development banks can provide catalytic funding to help countries scale private-public partnerships for sustainable rice.

The Islamic Development Bank (IsDB) is responding to a request from member countries in Sub-Saharan Africa, which want to lift domestic production to minimise their dependence on rice imports. These countries include: Benin, Burkina Faso, Cote D'Ivoire, The Gambia, Guinea, Mali, Niger, Senegal, Sierra Leone, and Sudan. A new programme will seek to substantially lift production and productivity, and develop effective, profit-oriented national and regional value chains with strong private sector participation, to directly improve the livelihoods of 2 million smallholder households. The programme will invest in infrastructure development including: critical production and post-harvest infrastructure, better-quality seeds and fertilizers, and public-private partnerships to strengthen value chains.

The initial estimated investment is $300 million, of which IsDB is expected to finance $175 million, $25 million will come from the 10 beneficiary countries and $100 million from development partners such as the Gates Foundation, the Kingdom of Saudi Arabia, United Arab Emirates and Qatar.[200] In addition, the Sustainable Rice Landscapes Initiative (SRLI), established in 2017 through a partnership between the WBCSD, SRP, UN FAO, UN Environment Program, IRRI and the GIZ, focuses on both on farm sustainable cultivation, as well as the restoration of upland forests and mangroves in rice growing landscapes. SRLI is receiving funding from the Global Environment Facility (GEF) based on its focus on public-private collaboration to ensure economically viable rice value chain development, with $100 million of financing for ten rice growing countries across Asia.

BLUEPRINT 3

LEVERAGE INTERNATIONAL CLIMATE FINANCE TO ATTRACT PRIVATE SECTOR INVESTMENT FOR CLIMATE-SMART RICE PRODUCTION

Action Recommendations

Recommendation 1

West African countries that already receive donor funds for climate-smart rice development should consider issuing a sovereign green bond to attract private investors to develop the rice sector.

A sovereign green bond could help developing countries attract international investors in climate-smart agriculture, unlocking capital for governments to support through blended finance mechanisms or investing in infrastructure, such as smart irrigation, which could increase paddy yields in some areas of West Africa by up to 300% and consolidate transboundary water security in the region.[201] Such an instrument could be linked to a country's NDC, National Adaptation Plan (NAP) for agriculture, or National Agricultural Investment Plan (NAIP)'s irrigation targets.

These instruments could build on the performance metrics outlined by SRP to report on eligible projects. West African governments that are interested in exploring this mechanism can leverage the support of key stakeholders that are actively investing resources and expertise in scaling smart irrigation in the region, including the World Bank Group, the Islamic Development Bank, and Helvetas — the Swiss development organisation that is working with 17 private and public sector partners to improve the water productivity of rice farmers in the region.

Recommendation 2

Multilateral climate funds should consider supporting national governments in preparing for the planning, design and issuance of a sovereign green bond for climate-smart rice investments.

The preparation stages for developing and issuing such instruments will require concessional finance. Funding could be provided by multilateral support programs such as the African Development Bank's Green Bond programme; the $1.2 billion Pilot Programme for Climate Resilience (PPCR) of the Climate Investment Funds (CIFs), the Global Environment Facility (GEF) or the Green Climate Fund (GCF) to help governments and implementing agencies design the mechanisms to leverage climate finance for sustainable rice production. These programmes support developing countries and regions to build their adaptation and resilience to the impacts of climate change and can catalyse through grant funding, the development of new climate financing mechanisms applied to adaptation in agriculture.

Recommendation 3

Agribusinesses and international donors can collaborate to develop blended finance funds that increase the support and financing directly to smallholder farmers and helps to mobilise the domestic financial sector.

The UN Capital Development Fund, a UN agency equipped to develop and test blended finance instruments in developing countries, has a deep base of technical expertise on creating and structuring new financial tools and is well positioned to partner with agribusinesses to pilot mechanisms to de-risk local bank loans to farmers. For instance, using donor funding, UNCDF could create a guarantee for local banks in a few pilot countries to encourage them to lend to local farmers in a particular value chain, including work with local financial service providers to digitize payments to improve the speed, transparency and efficiency of transactions to and from farmers.

Recommendation 4

Agribusiness and international donors can collaborate to develop and scale nature- and landscape-based solutions for sustainable rice.

The Sustainable Rice Landscapes Initiative (SRLI) should investigate the potential to use market-based climate finance mechanisms to scale forest, soil and watershed restoration in rice growing regions. This could enable governments to use regulatory mechanisms to meet their NDC commitments, while also financing landscape restoration for the benefit of natural resources and ecosystem services for rice overall productivity. Carbon market mechanisms could also be used to incentivise on farm rice GHG reductions, while further strengthening farmer support and value chains for low or zero carbon rice production.

BLUEPRINT 3

LEVERAGE INTERNATIONAL CLIMATE FINANCE TO ATTRACT PRIVATE SECTOR INVESTMENT FOR CLIMATE-SMART RICE PRODUCTION

CASE STUDY
INDONESIA'S GREEN SUKUK

In 2018, Indonesia issued a $1.25 billion "green sukuk" (Shari'ah compliant securities backed by a specific pool of assets, otherwise known as an 'Islamic green bond') to support the implementation of its climate change mitigation targets, as set out in its NDC, as well as its climate adaptation plan, which is integrated in the National Development Plan.

The green sukuk includes sustainable agriculture among eligible sectors under a budget tagging process to identify climate change spending. The process is being expanded to cover both climate change mitigation and adaptation expenditures under 17 ministries.

Eligible green sukuk projects are selected from expenditures in ministry budgets that are tagged to have climate change benefits in line with Indonesia's climate objectives. The proceeds will be managed within the Government's general account until proceeds are transferred into the account of the relevant ministries for funding exclusively eligible projects.

The budget tagging process starts with the environmental benefits of each project being assessed by the individual ministries together with the Climate Change Secretariat of the National Development Planning Agency. The Ministry of Environment and Forestry confirms that the expenditure is consistent with Indonesia's NDC. It is then endorsed by the Ministry of Finance as being tagged for budget allocation.

Almost 30% of proceeds are allocated to sustainable agriculture, afforestation and rainforest conservation, as well as climate change adaptation measures. The bond framework aligns with the Green Bond Principles, the ASEAN Green Bond Standards, and Indonesia's Financial Services Authority's green bond regulations.[202]

4.2 THE NEXT FRONTIER FOR BUSINESS DIPLOMACY

Private sector advocacy is needed to help governments support sustainable rice at a landscape level

While the private sector is a key driver of innovation, government policies and an enabling regulatory framework that incentivise sustainable practices are needed for these innovations to be implemented at scale. Ultimately, governments have the greatest leverage to define a sustainable path for rice production systems and markets at scale. Private sector companies at the forefront of the sustainable rice agenda will be more successful in a market that incentivises sustainable behaviour and penalises unsustainable practices.

In order to champion this market environment, companies must develop new ways of supporting, informing and influencing governments to drive a wider transition towards sustainable production and trade.

Pathways for business diplomacy

There are three ways in which private sector companies can work with governments, advance blended finance mechanisms or engage in policy advocacy, working through innovative coalitions such as the Sustainable Rice Platform (SRP) and the Sustainable Rice Landscapes Initiative (SRLI):

Pathway 1
Help governments prioritise infrastructure investments to support sustainable rice

Governments also play a critical role in infrastructure development. This includes physical infrastructure such as building roads, logistics and irrigation systems. Government investments in infrastructure in Asia have played a key role in developing the rice value chain.[203] It also includes financial infrastructure, such as the creation of national-scale funds that use subsidies and other public finance instruments to make financing available to smallholder farmers. For example, the Thai government has developed a national rice insurance scheme that will benefit over 4 million farmers.[204] Private sector guidance in particular can help governments identify opportunities for specific types of physical or financial infrastructure that can attract and leverage private sector-led value chains and financial mechanisms.

Pathway 2
Advocate for regulatory policies that incentivise climate-smart behaviour

Given the strategic importance of rice to political stability and security, governments commonly intervene to influence domestic prices and policies. This can range from public procurement to releasing rice from stocks or changes in trade policies. This includes environmental requirements, setting subsidy levels, strengthening property rights systems and impacting the costs of inputs such as water and energy, all of which shape the economic behaviour of farmers and the entire value chain. For example, in Bangladesh, a major barrier to the adoption of the Alternate Wetting and Drying (AWD) practice was found to be the absence of any water pricing, which removed the incentive for farmers to reduce their water consumption.[205]

Pathway 3
Advocate for trade tariff reforms to incentivise sustainable rice

Since rice is one of the most protected traded commodities, there is considerable scope for market liberalization. Import and export tariffs will impact the market price of rice and quantities and flow of trade.[206] A coalition of private, public and civil society stakeholders working under the framework of the Sustainable Rice Platform (SRP) can advocate for a tariff reduction or exemption for sustainable rice, through a new Customs Code under the Harmonized Commodity Description and Coding System (HS). Representations would also need to be considered at the level of the World Trade Organisation (WTO). Qualifying for a tariff reduction would be based on third-party assurance of the SRP standard. A reduction in tariffs for sustainably-grown rice could offer a game-changing incentive for traders and exporters to find new pathways to procure and trade sustainable rice, which could in turn be passed on to farmers to incentivise a wide-scale transformation to sustainably produced rice.[207]

4.2
THE NEXT FRONTIER FOR BUSINESS DIPLOMACY

CASE STUDY

INNOVATIVE COALITIONS: THE SUSTAINABLE RICE LANDSCAPES INITIATIVE (SRLI)

SRLI aims to build the private and public delivery ecosystem to streamline sustainable rice at scale.

Since 2017, the SRLI's six global partners which combined global business, government policy and technical know-how, have been working to deliver GHG emissions cuts in rice production, minimise environmental impacts, and make farmers more resilient. The partners are the WBCSD, UN Environment, the UN Food and Agriculture Organization (FAO), the Sustainable Rice Platform (SRP), the German Corporation for International Cooperation (GIZ), and the International Rice Research Institute (IRRI).

SRLI delivers an integrated approach to transition to sustainable rice landscapes, combining:

— **Policy and planning** to strengthen national government policy and institutional development for sustainable rice (e.g. policy instruments for land use planning, financing instruments).

— **Production practices** that address on-farm and landscape-level needs and linkages (e.g. technical training on proven methods such as Alternate Wetting and Drying, improved watershed planning).

— **Market-based instruments** supporting efficient and sustainable value chains (e.g. adoption of SRP standard), maximising productivity/economic margins, creating value chain wide approaches.

— **Knowledge management**, metrics and monitoring systems (e.g. adoption of ICT-enabled decision support tools, metrics that address MRV and carbon financing options, standardized metrics).

SRLI is being applied in rice-growing landscapes of SE Asia (e.g. Mekong Delta countries) and South Asia with opportunities for scale across West Africa and Latin America. Key current countries are Thailand and Vietnam. SRLI will help to deploy financing to players ranging from government ministries to implementing partners and regional initiatives. It will bring together multiple initiatives undertaken by its partner organizations, including the Sustainable Rice Platform (SRP), Better Rice Initiative (GIZ), Source to Sea (FAO), Climate Smart Agriculture project (WBCSD), GEF Food, Land Use and Restoration Impact Programme (FOLUR) and Low Carbon Rice (IRRI). The initiative will be funded by a range of international climate finance funds and facilities. The SRP standard provides a clear performance monitoring framework that can help countries to quantify targets and progress.

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Financing Sustainable Rice for a Secure Future
Innovative Finance Partnerships for Climate Mitigation and Adaptation

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1 'The global staple', Ricepedia. Available at: http://ricepedia.org/rice-as-food/the-global-staple-rice-consumers (accessed 19 July 2019).

2 'Study on Per Capita Rice Consumption and Ratio of Household Expenditure in Myanmar', Myint, T., 2016.

3 'Rising Food Prices Discussion paper', UNICEF, 2008.

4 'Potential Impact of Higher Rice Prices on Poverty: Summary Estimates for a Dozen West and Central African Countries', Wodon, Q., Tsimpo, C., Backiny-Yetno, P., Joseph, G., Adoho, F. and Coulombe, H., World Bank Policy Research Working Paper 4745, 2008.

5 'Farmers' Net Income Distribution and Regional Vulnerability to Climate Change: An Empirical Study of Bangladesh', Alamgir, M.S., Furuya, J., Kobayashi, S., Binte, M.R., and Salam, M.A., Climate, 2018.

6 'Mapping regional risks from climate change for rainfed rice cultivation in India', Singh, K., McClean, C.J., Buker, P., Hartley, S.E., and Hill, J.K., Agricultural Systems 156, 2017.

7 'The Poverty Impacts of Climate Change: A Review of the Evidence', Skoufias, E., Rabassa, M., and Olivieri, S., World Bank Policy Research Working Paper 5622, 2011.

8 'Climate change', Ricepedia. Available at: http://ricepedia.org/challenges/climate-change (accessed 19 July 2019).

9 'Salinity Intrusion in a Changing Climate Scenario will Hit Coastal Bangladesh Hard', The World Bank, 2015.

10 'Rice and climate change: significance for food security and vulnerability', Mohanty, S., Wassmann, R., Nelson, A., Moya, P., and Jagadish, S.V.K., International rice research Institute, 2013.

11 'Climate change impacts on rice in Africa', Zwart, S. and van Oort, P., Rice Today, 2018.

12 'Climate change, rice production, and migration in Vietnamese households', Baronchelli, A., and Ricciuti, R., United Nations University WIDER Working Paper 2018/86, 2018.

13 'Climate Change: Activities of Selected Agencies to Address Potential Impact on Global Migration', United States Government Accountability Office, 2019.

14 Thirsty Crops: Our food and clothes: eating up nature and wearing out the environment?', Worldwide Fund for Nature, 2013.

15 'Rice Almanac', Global Rice Science Partnership, 2013.

16 'Water management in irrigated rice: Coping with water scarcity', Bouman, B.A.M., Lampayan, R.M., and Toung, T.P., International Rice Research Institute (IRRI), 2007.

17 'Rice Almanac', Global Rice Science Partnership, 2013.

18 'Rice Almanac', Global Rice Science Partnership, 2013.

19 'Rice and water', Crop and Environmental Sciences Division, International Rice Research Institute, Los Banos, Philippines.

20 'Water management in irrigated rice: Coping with water scarcity', Bouman, B.A.M., Lampayan, R.M., and Toung, T.P., International Rice Research Institute (IRRI), 2007.

21 'The paddy compulsion', Sood, J., DownToEarth, 2015.

22 'Rice Almanac', Global Rice Science Partnership, 2013.

23 'Olam calls for urgent international cooperation to reduce major greenhouse gas footprint of rice production', Olam, 2018.

24 'How countries plan to address agricultural adaptation and mitigation: An analysis of Intended Nationally Determined Contributions. CCAFS dataset', CGIAR. Available at: https://cgspace.cgiar.org/handle/10568/73255 (accessed 6 September 2019).

25 'Agriculture's prominence in the INDCs: data and maps', CGIAR Research Programme on Climate Change, Agriculture and Food Security, 2015.

26 'Intended Nationally Determined Contributions (INDC)', Ministry of Environment and Forests, Government of the People's Republic of Bangladesh, 2015.

27 'Info Note: How countries plan to address agricultural adaptation and mitigation; An analysis of Intended Nationally Determined Contributions', Richards, M., Bruun, T.B., Campbell, B.M., Gregersen, L.E., Huyer, S., Kuntze, V., Madsen, S.T.N., Oldvig, M.B., and Vasileiou, I., CGIAR Research Programme on Climate Change, Agriculture and Food Security, 2015.

28 Thai Rice NAMA, NAMA Facility profile https://www.nama-facility.org/projects/thailand-thai-rice-nama/ (accessed 21 October 2019).

29 'Rice Facts', Sustainable Rice Platform. Available at: http://www.sustainablerice.org/Resources/ (accessed 19 July 2019).

30 'Rice Almanac', Global Rice Science Partnership, 2013.

31 'Rice Almanac', Global Rice Science Partnership, 2013.

32 'RICE Flagship project 2: Upgrading rice value chains', CGIAR Research Programme on Rice, 2017.

33 Mars Food interview, June 12th, 2019.

34 'Agricultural cooperatives improve people's livelihoods', Chiphwanya, O., The Nation, 2018.

35 'Empowerment of women smallholder farmers in the rice value chain', Lusuva, E., SNV, 2015.

36 'Why is the price of rice so volatile?' Zorya, S., World Economic Forum, 2014.

37 'Rice Trade and Price Volatility: Implications on ASEAN and Global Food Security' Clarete, R.L., Adriano, L. and Esteban, A., Asian Development Bank, 2013.

38 'Exploring food price scenarios towards 2030 with a global multi-region model', Willenbockel, D., Oxfam, 2011.

39 'Country responses to the food price crisis 2007/08: Case studies from Bangladesh, Nicaragua, and Sierra Leone', Wiggins, S., Compton, J., Keats, S., and Davies, M., Overseas Development Institute, 2010.

40 'Exploring food price scenarios towards 2030 with a global multi-regional model', Willenbockel, D., Oxfam, 2011.

41 'The Rice Crisis: Markets, Policies and Food Security', ed. Dawe, D., Food and Agriculture Organization of the United Nations/Earthscan, 2010.

42 'Inside Haiti's food riots', Al Jazeera, 2008.

43 'Haiti's government falls after food riots', Delva, J.G., and Loney, J., Reuters, 2008.

44 'Asia' in 'Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects, Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change', Hijioka, Y., Lin, E., and Pereira, J.J., 2014.

45 'Colombia could lose 60% of land suitable for irrigated rice due to climate change', International Center for Tropical Agriculture (CIAT), 2019.

46 'The Poverty Implications of Climate-Induced Crop Yield Changes by 2030', Hertel, T.W., Burke, M.B., and Lobell, D.B., Global Trade Analysis Project (GTAP), 2010.

47 'Exploring food price scenarios towards 2030 with a global multi-regional model', Willenbockel, D., Oxfam, 2011.

48 'Rice in the Shadow of Skyscrapers: Policy Choices in a Dynamic East and Southeast Asian Setting', Food and Agriculture Organisation of the United Nations, 2014.

49 'Myanmar: Capitalizing on Rice Export Opportunities', The World Bank Southeast Asia Sustainable Development Unit, 2014.

50 'Thailand's Rice Industry and Current Policies towards High Value Rice Products', Pongsrihadulchai, A., FFTC Agricultural Policy Platform (FFTC-AP), Food and Fertilizer Technology Center for the Asian and Pacific Region, 2018.

51 'Technical Assistance Consultant's Report: The Rice Situation in Cambodia', Kean, S., Asian Development Bank, 2012.

[52] 'Rice Almanac', Global Rice Science Partnership, 2013.
[53] 'Briefing Paper: Land Rights and Business in Myanmar', Myanmar Centre for Responsible Business, 2018.
[54] 'Sharing growth: equity and development in Cambodia', World Bank, 2007.
[55] 'Systematic Land Registration in Rural Areas of Lao PDR: Concept Document for countrywide application', GIZ, 2015.
[56] 'Sharing growth: equity and development in Cambodia', World Bank, 2007.
[57] 'The Little Data Book on Financial Inclusion 2018', World Bank Group, 2018.
[58] 'Digital 2019: Global Digital Overview', DataReportal, 2019.
[59] 'Financing agriculture value chains in the digital age', Asian Development Blog, 2017.
[60] 'Cambodia Must Up Its Game in Rice Exports', Khut, I., Asia Foundation, 2013.
[61] 'Reducing Postharvest Losses during Storage of Grain Crops to Strengthen Food Security in Developing Countries', Kumar, D. and Kalita, P., Foods, 2017.
[62] 'Salinity Intrusion in a Changing Climate Scenario will Hit Coastal Bangladesh Hard', The World Bank, 2015.
[63] 'The Lower Mekong Dams Factsheet Text', Tieng Viet, 2013.
[64] 'Lancang River Dams: Threatening the Flow of the Lower Mekong', International Rivers, 2013.
[65] 'Climate change affecting land use in the Mekong Delta: Adaptation of rice-based cropping systems (CLUES)', Ngo, D.P. and Wassmann, R., Australian Centre for International Agricultural Research, 2009.
[66] 'Rice-Residue Management Practices of Smallholder Farms in Vietnam and Their Effects on Nutrient Fluxes in the Soil-Plant System', Dao, T.H., Hughes, H.J., Keck, M., and Sauer, D., Sustainability, 2019.
[67] 'Emission of Air Pollutants from Rice Residue Open Burning in Thailand, 2018', Junpen, A., Pansuk, J., Kamnoet, O., Cheewaphongphan, P., and Garivait, S., Atmosphere, 2018.
[68] 'Status of Straw Management in Asia-Pacific and Options for Integrated Straw Management', United Nations Economic and Social Commission for Asia and the Pacific Centre for Sustainable Agricultural Mechanization (ESCAP-CSAM), 2018.
[69] 'Economic Analysis of Rice Straw Management Alternatives and Understanding Farmers' Choices', Launio, C.C., Asis, C., Manalili, R., and Fernandez Javier, E., WorldFish Economy and Environment Program for Southeast Asia, 2013.
[70] The NAMA Facility. Thailand: Thai Rice NAMA: https://www.nama-facility.org/projects/thailand-thai-rice-nama/ (accessed Sept 25, 2019)
[71] The NAMA Facility, Stories: Better Rice http://stories.nama-facility.org/better-rice
[72] 'ECOWAS Rice Factbook', GrowAfrica, 2014.
[73] 'ECOWAS Rice Factbook', GrowAfrica, 2014.
[74] 'Cote d'Ivoire', Food Fortification Initiative/Global Alliance for Improved Nutrition (GAIN), 2015.
[75] 'ECOWAS Rice Factbook', GrowAfrica, 2014.
[76] 'ECOWAS Rice Factbook', GrowAfrica, 2014.
[77] 'Rice Almanac', Global Rice Science Partnership, 2013.
[78] 'Rice Almanac', Global Rice Science Partnership, 2013.
[79] 'Assessing the State of the Rice Milling Sector in Nigeria: The Role of Policy for Growth and Modernisation', Johnson, M. and Masias, I., International Food Policy Research Institute, 2016.
[80] 'Prevalence of undernourishment', FAOSTAT. Available at: http://www.fao.org/faostat/en/#data/FS (accessed 16 August 2019).
[81] 'Lessons from the rice crisis: Policies for food security in Africa', AfricaRice, 2011.
[82] 'Literacy rate, adult total (% of people ages 15 and above)', World Bank/UNESCO Institute of Statistics. Available at: https://data.worldbank.org/indicator/se.adt.litr.zs (accessed 16 August 2019).
[83] 'E-Agriculture Promising Practice: Rice Crop Manager and RiceAdvice — Decision tools for rice crop management', Food and Agriculture Organisation of the United Nations, 2018.
[84] 'Learning & Innovation: Rural Learning', AfricaRice. Available at: http://www.africarice.org/warda/p3-rurallearning.asp (accessed 16 August 2019).
[85] 'Rice crisis, market trends, and food security in West Africa', World Food Programme, 2010.
[86] 'ECOWAS Rice Factbook', GrowAfrica, 2014.
[87] 'Rice Almanac', Global Rice Science Partnership, 2013.
[88] 'Manual of Good Practices in Small Scale Irrigation in the Sahel: Experiences from Mali', GIZ, 2014.
[89] 'Making Every Drop Count: Drip Irrigation and Rice Production in Mali', Dexis Consulting Group, 2019.
[90] 'Enterprise Surveys: What Businesses Experience', World Bank Group. Available at: https://www.enterprisesurveys.org/ (accessed 16 August 2019).
[91] 'Integrated Approaches to Food Security and Nutrition: A Trip Report of the CSIS Delegation to Senegal, August 2016', Center for Strategic and International Studies, 2016.
[92] 'Assessment of Processing Efficiency of SME Rice Mills in Nigeria', Pham, V.T., GIZ Nigeria, 2016.
[93] 'Agsol's solar-powered mills help promote universal energy access', Sustainable Energy for All (SE4All), 2019.
[94] 'Turning rice residues into energy in combined heat and power systems in Turkey: Bioenergy and Food Security (BEFS) case study', Food and Agriculture Organisation of the United Nations, 2018.
[95] 'The Little Data Book on Financial Inclusion 2018', World Bank Group, 2018.
[96] 'Rising with rice in Cote d'Ivoire 1: How local farmers and millers are leading the way', Karlen, R. and Christiaensen, L., World Bank Blogs, 2019.
[97] 'Accelerating the ECOWAP/CAADP implementation: Strategic policy paper on the regional offensive for sustainable rice production in West Africa', Economic Community of West African States (ECOWAS), Department of Agriculture, Environment and Water Resources, 2012.
[98] 'Water-Wise: Smart Irrigation Strategies for Africa', Malabo Montpellier Panel, 2018.
[99] 'Dakar Declaration on Irrigation', High-Level Political Forum on Irrigation, 2013.
[100] 'West Africa Sahel Irrigation Initiative Support Project', World Bank, 2017.
[101] 'CAADP Overview', NEPAD.org. Available at: https://www.nepad.org/caadp/overview (accessed 25 September 2019).
[102] 'National Agricultural Investment Plan', Federal Republic of Nigeria Federal Ministry of Agriculture and Rural Development, 2010.
[103] 'Plan national d'investissement prioritaire dans le secteur agricole (PNIP-SA) du Mali', Republique du Mali, 2010.
[104] 'Programme nationale d'investissement agricole', Republique du Senegal, 2011.
[105] 'Mali Small-Scale Irrigation Project', United States Agency for International Development (USAID), 2016.
[106] 'Strategic Framework for Agricultural Water', Initiative pour l'Irrigation au Sahel (2iS), 2017.
[107] 'Strategic Framework for Agricultural Water', Initiative pour l'Irrigation au Sahel (2iS), 2017.
[108] 'West Africa Sahel Irrigation Initiative Support Project', World Bank, 2017.
[109] 'Water-Wise: Smart Irrigation Strategies for Africa', Malabo Montpellier Panel, 2018.
[110] 'Making Every Drop Count: Drip Irrigation and Rice Production in Mali', Dexis Consulting, August 2, 2019.

[111] 'The Sustainable Rice Platform calls for private-public partnerships to secure sustainable global rice supply', Sustainable Agrifood Systems in ASEAN, 2019.
[112] 'Competitive African Rice Initiative (CARI): Empowering small-scale rice farmers.
[113] 'Rice farmers in Viet Nam earn more income through the use of integrated pest management methods', Sustainable Agrifood Systems in Asean, 2017.
[114] 'Benefits and costs of climate change mitigation technologies in paddy rice: Focus on Bangladesh and Vietnam', Basak, R., CGIAR Research Program on Climate Change, Agriculture and Food Security Working Paper no. 160, 2016.
[115] 'How sustainable rice farming in Vietnam is increasing revenue while reducing greenhouse gas emissions', Rudek, J., Environmental Defense Fund, 2016.
[116] 'Sustainable Rice Platform (SRP) Sustainable Rice Cultivation: Enabling Private Sector Climate-Smart Agriculture and Forestry Investment in Southeast Asia', United States Agency for International Development (USAID), 2018.
[117] 'Consumers willing to pay a premium for sustainably produced rice, a new study shows', IRRI, 2018.
[118] 'Paving the way for sustainable rice production in Asian countries', IRRI, 2018.
[119] '50,000 Farmers in 13 Counties: Results from Scaling up the System of Rice Intensification in West Africa', Styger, E. and Traore, G., The West and Central Africa Council for Agricultural Research and Development (CORAF), 2018.
[120] 'The loan investment in Mrs. Thoung rice farming helped her to get a high yield', Lend With Care, 2019.
[121] 'Financing family rice farming to improve performance of large dams', Global Water Initiative West Africa, 2016.
[122] 'Let's Get Digital: Un-Blocking Finance for Farmers in Senegal', Feed the Future Senegal Naatal Mbay, 2018.
[123] 'New irrigation technique can ease drought effects for rice farmers', CGIAR Research Program on Climate Change, Agriculture and Food Security, 2014.
[124] 'Benefits and costs of climate change mitigation technologies in paddy rice: Focus on Bangladesh and Vietnam', Basak, R., CGIAR Research Program on Climate Change, Agriculture and Food Security Working Paper no. 160, 2016.
[125] ''No regret' mitigation strategies in rice production', IRRI. Available at: http://climatechange.irri.org/projects/mitigation/assessing-incentives-for-scaling-up-mitigation-at-different-stakeholder-levels-no-regret-mitigation-strategies-in-rice-production (accessed 18 September 2019).
[126] 'Rice Straw Management', IRRI. Available at: https://www.irri.org/rice-straw-management (accessed 18 September 2019).
[127] 'Olam calls for urgent international cooperation to reduce major greenhouse gas footprint of rice production', Olam, 2018.
[128] 'How to manage pests and diseases', IRRI Rice Knowledge Bank. Available at: http://www.knowledgebank.irri.org/step-by-step-production/growth/pests-and-diseases (accessed 28 August 2019).
[129] '"Outsmarting" pests and diseases on farms', Celeridad, R.L., CGIAR Research Program on Climate Change, Agriculture and Food Security, 2018.
[130] 'Rice farmers in Viet Nam earn more income through the use of integrated pest management methods', Sustainable Agrifood Systems in Asean, 2017.
[131] 'Rice Almanac', Global Rice Science Partnership, 2013.
[132] 'Impacts of Site-Specific Nutrient Management in Irrigated Rice Farms in the Red River Delta, Northern Vietnam', Rodriguez, D.G.P. and Nguyen, T.D.N., 2012.
[133] 'Laser land levelling', International Rice Research Institute (IRRI). Available at: http://ghgmitigation.irri.org/technologies/laser-land-leveling (accessed 22 August 2019).
[134] 'Laser land levelling: How it strikes all the right climate-smart chords', CGIAR Research Program on Climate Change, Agriculture and Food Security, 2015.
[135] 'SRI Methodologies', Cornell University College of Agriculture and Life Sciences, SRI International Network and Resources Center. Available at: http://sri.ciifad.cornell.edu/aboutsri/methods/index.html (accessed 18 September 2019).
[136] 'System of Rice Intensification (SRI)', Selvaraju, R., Food and Agriculture Organization of the United Nations (FAO), 2013.
[137] 'Building capacity for integrated rice-fish systems through the Regional Rice Initiative and South-South cooperation', Food and Agriculture Organization of the United Nations (FAO), 2017.
[138] 'Scaling-Up integrated rice-fish systems: Tapping ancient Chinese know-how', Food and Agriculture Organization of the United Nations (FAO), 2019.
[139] 'Goals of the C4 Rice Project', The C4 Rice Project: Driven by the Future Needs of Developing World Agriculture. Available at: https://c4rice.com/the-project-2/project-goals/ (accessed 18 September 2019).
[140] 'Rice Almanac', Global Rice Science Partnership, 2013.
[141] 'Rice Almanac', Global Rice Science Partnership, 2013.
[142] 'Rice Almanac', Global Rice Science Partnership, 2013.
[143] 'Rice Almanac', Global Rice Science Partnership, 2013.
[144] 'Rice Almanac', Global Rice Science Partnership, 2013.
[145] 'Rice Almanac', Global Rice Science Partnership, 2013.
[146] 'Rice Value Chain Report', Eastern Archdiocesan Development Network (EADEN), 2017.
[147] 'Agricultural value chain finance: tools and lessons', Miller, C. and Jones, L., Food and Agriculture Organisation of the United Nations/Practical Action Publishing, 2010.
[148] 'Rice Almanac', Global Rice Science Partnership', 2013
[149] 'Case Study: Modernising the Rice Sector in Cambodia', World Bank Group, 2018.
[150] 'Accelerating the ECOWAP/CAADP implementation: Strategic policy paper on the regional offensive for sustainable rice production in West Africa', Economic Community of West African States (ECOWAS), Department of Agriculture, Environment and Water Resources, 2012.
[151] Phoenix Agrifoods; 2019; https://www.phoenixgroup.net/agrifoods
[152] 'Cambodia: Mobilizing credit for agriculture with an emphasis on women-owned businesses', USAID Development Credit Authority, 2019.
[153] 'Innovative financing for agriculture, food security and nutrition: Report of the High-Level Expert Committee to the Leading Group on Innovative Financing for agriculture, food security and nutrition', High-Level Expert Committee to the Leading Group on Innovative Financing for agriculture, food security and nutrition', 2012.
[154] 'Innovative financing for agriculture, food security and nutrition: Report of the High-Level Expert Committee to the Leading Group on Innovative Financing for agriculture, food security and nutrition', High-Level Expert Committee to the Leading Group on Innovative Financing for agriculture, food security and nutrition', 2012.
[155] '3.5 Catalysts for investment', Unlocking Forest Finance: Financing Sustainable Landscapes, Global Canopy. Available at:

http://financing sustainablelandscapes.org/channeling-investment/catalysts-investment (accessed 18 September 2019).

156 'Scaling up of Sahel rice varieties in Senegal: Review of successful scaling of agricultural technologies', United States Agency for International Development (USAID), 2016.

157 'Making Climate Finance Work in Agriculture: Discussion Paper', World Bank Group, 2016.

158 'Making Climate Finance Work in Agriculture: Discussion Paper', World Bank Group, 2016.

159 'How Mars is helping to slash water use in growing rice', Ethical Corporation, November 28, 2018

160 'The agricultural sectors in nationally determined contributions (NDCs): Priority areas for international support', Food and Agriculture Organisation of the United Nations (FAO), Rome, 2016.

161 'Market size and opportunity in digitising payments in agricultural value chains', GSMA analysis, 2016.

162 'The Future of Supply Chains, Why Companies are Digitizing Payments', Better Than Cash Alliance, 2018.

163 Mastercard and Rabobank Join to Bring Financial Inclusion Tools to 1 Million Farmers, Press Release, Sept 25 2019.

164 'Digital Solutions Directory', GrowAsia. Available at: https://growasiadirectory.org/?category%5B0%5D=finance&category%5B1%5D=insurance&category%5B2%5D=payment&crop%5B0%5D=rice&country&s (accessed 18 September 2019)

165 'How bundled services are impacting over a million smallholders', Closing the Digital Divide, mStar, 2018.

166 'The digitalisation of African agriculture report 2018-2019', The Technical Centre for Agricultural and Rural Cooperation (CTA)/Dalberg, 2019.

167 'Yara and IBM join forces to transform the future of farming', Press Release, IBM News Room, April 2019.

168 'Mobile Financial Services Indicators for Measuring Access and Usage', Alliance for Financial Inclusion, Guideline No. 11.

169 'Digital agriculture in Kenya: How is it enabling financial inclusion for farmers?; GSMA, July 2019.

170 'The Mobile Money Regulatory Index'; GSMA; February 2019.

171 'The Role of Digital Payments in Sustainable Agriculture and Food Security', Better Than Cash Alliance, 2017.

172 'AXA expands insurance for rice farmers in Indonesia', Olano, G., Insurance Business Asia, 2016.

173 'The GSMA Innovation Fund for Digitisation of Agricultural Value Chains' GSMA Mobile for Development, 2019.

174 'Digital Olam in the making', Olam Insights, 2019.

175 'Thailand approves $682 million in new rice insurance scheme', Reuters, August 21, 2019.

176 'Remote Sensing-based Information and Insurance for Crops in Emerging Economies (RIICE)'. Available at: http://www.riice.org/about-riice/about-riice/ (accessed on 18 September 2019).

177 'An Agriculture Use Case for ID: An Overview of the Mastercard Farmer Network', Mogus, A., Mastercard Lab for Financial Inclusion, 2019.

178 'Green Finance: Modest 2018 Growth Masks Strong Market Fundamentals For 2019', S&P Global Ratings, 2019.

179 'Green Bond Principles: Voluntary Process Guidelines for Issuing Green Bonds', International Capital Markets Association, 2018.

180 'Agriculture Criteria: Why develop eligibility Criteria for agriculture-related low carbon investments', Climate Bonds Initiative. Available at: https://www.climatebonds.net/agriculture (accessed 18 September 2019).

181 '2019 Status Report: Task Force on Climate-related Financial Disclosures', Task Force on Climate-related Financial Disclosures, 2019, 2019.

182 'The world's first "Humanitarian Impact Bond" launched to transform financing of aid in conflict-hit countries', International Committee of the Red Cross, September 6, 2017.

183 'State of the Sector 2019', Council on Smallholder Agriculture Finance (CSAF).

184 'Rabobank and UN Environment kick-start $1 billion program to catalyze sustainable food production' Rabobank, 2017.

185 'ING's sustainability improvement loan'. Available at: https://www.ingwb.com (accessed Sept 12, 2019)

186 'Olam International secures Asia's first sustainability-linked club loan facility of $500.0 million', Olam 2018.

187 'Award for innovation bond structure: Tropical Landscapes Finance Facility project bonds', Environmental Finance, 2019.

188 'WFP Supply Chain: 2018 Review", World Food Programme, 2019

189 'Update on Food Procurement', agenda Item for WFP Executive Board Annual session, Rome, 10–14 June 2019, World Food Programme, 2019.

190 'Responsible Commodities Facility Instrument Analysis', Brazil Innovation Lab for Climate Finance, 2018.

191 'The agricultural sectors in nationally determined contributions (NDCs): Priority areas for international support', Food and Agriculture Organisation of the United Nations (FAO), Rome, 2016.

192 'Making Climate Finance Work in Agriculture: Discussion Paper', World Bank Group, 2016.

193 'Agriculture's prominence in the INDCs: data and maps', CGIAR Research Programme on Climate Change, Agriculture and Food Security, 2015.

194 'The Economic Potential of Article 6 of the Paris Agreement and Implementation Challenges', IETA, University of Maryland and CPLC. Washington, D.C. License: Creative Commons Attribution CC BY 3.0 IGO.

195 'Sovereign Green Bond Briefing' Climate Bonds Initiative 2018.

196 'Better Finance, Better World: Consultation Paper of the Blended Finance Taskforce', Blended Finance Taskforce, 2028.

197 'Blended Finance Tools to Catalyze Investment in Agricultural Value Chains: An initial toolbox', Dalberg Global Investors. Available at: https://docs.wixstatic.com/ugd/7f0ffd_9f5c087576d345c39701c3a495d268c6.pdf

198 BUILD Fund brief, Bamboo Capital Partners.

199 'The West African Initiative for Climate-Smart Agriculture (WAICSA)', Climate Lab Instrument Analysis, September 2019.

200 'Regional rice value chain programme brief', Islamic Development Bank, 2018.

201 'Water-Wise: Smart Irrigation Strategies for Africa', Malabo Montpellier Panel, 2018.

202 'Sovereign Green Bond Briefing' Climate Bonds Initiative 2018.

203 'The quiet revolution in Asia's rice value chains', Reardon, T., Chen, K.Z., Minten, B., Adriano, L., Dao, T.A., Wang, J., and Gupta S.N., Annals of the New York Academy of Sciences: Paths of Convergence for Agriculture, Health and Wealth, 2014.

204 'Thailand approves $682 million in new rice insurance scheme', Reuters, August 21, 2019.

205 'Case Studies on Farmers' Perceptions and Potential of AWD in Two Districts of Bangladesh', Rahman, M.S., Bangladesh Agricultural University, 2016.

206 'Opportunities and Challenges of Rice Business in Sub-Saharan Africa', Raina, R., Olam International, 2015.

207 'Tariffs', World Trade Organization. Available at: http://tariffdata.wto.org/ReportersAndProducts.aspx (accessed 18 September 2019).

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