



INDEPENDENT FINAL REVIEW

OF THE ASSURED ARTEMISININ SUPPLY SYSTEM

UNITAID

PARTNERS: I+SOLUTIONS, TRIODOS BANK, FSC, ARTEPAL

13 SEPTEMBER 2013

Acknowledgements

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All views represented in this evaluation are those of Dalberg and do not represent the views of UNITAID, the Project Management and Advisory Groups, or other entities quoted herein.

Executive Summary

The Assured Artemisinin Supply System (A2S2) project was launched by UNITAID in July 2009 to intervene in the market for artemisinin, a key active ingredient for artemisinin-based combination therapy (ACT) production. The main goal of the project was to contribute to the promotion of a stable supply of artemisinin at fair prices that would be sufficient to meet global ACT need. The project was designed as a collaborative effort between four implementing partners - i+solutions, Artepal, FSC Development Services, and Triodos Investment Management. The implementation team had two objectives:

1. to prevent an immediate expected shortage of artemisinin in 2011 by financing the production of an additional 40 metric tons, and
2. to improve the consistency and predictability of artemisinin supply through increased market transparency and development of a more formally structured market.

By June 2013, following two extensions, the project had spanned four years, closing in May 2013. During that time, it issued and maintained four loans to artemisinin extractors in two continents and disseminated market intelligence to a subscribed audience of approximately 500 people.

Final Review

This is an independent final evaluation of the project. The evaluation was initiated by the UNITAID Secretariat in July 2013 to be conducted by Dalberg Global Development Advisors. The purpose of this review is to 1) assess the performance and impact of the project over its lifetime, and 2) identify opportunities to improve the design or implementation of future projects.

The methodology can be found in Annex 1. This evaluation builds upon the mid-term evaluation that was completed in January 2011 by Dalberg Global Development Advisors to (1) assess the progress of the project to date and (2) identify opportunities for improvements.

Findings

Detailed findings from this evaluation can be found in Section 4.

Relevance: *High-medium*

- At the time of project approval, there was a need for innovative interventions to promote market stabilization (i) by providing working capital to extractors and (ii) by creating greater insight into projected future global and regional supply levels to inform planting decisions by producers and investment decisions by extractors.
- The project remained relevant throughout the course of the project, as the market remained volatile, extractors continued to need working capital, and market intelligence continued to be necessary to inform extractors' and producers' decisions.

Efficiency & Effectiveness: *Low-medium*

- A2S2 successfully completed all planned and approved activities on-budget, though the timelines were challenged in both components of the intervention: the pre-financing facility and the market intelligence program.

- The market intelligence program was ultimately effective in impacting market transparency.
 - A2S2’s market intelligence activities increased the availability of public and semi-public supply forecasts in the market and enabled more informed decision-making among market actors interviewed.
 - These effects became visible near the end of the extended project, after several iterations on how to disseminate the information through which the project team ultimately found a middle ground that satisfied both confidentiality concerns and publication goals.
- The pre-financing facility, however, had a more mixed record on efficiency and effectiveness: outputs from the pre-financing facility did not meet the project’s targets in terms of either the number of tons of artemisinin financed or the repayment of the loans themselves.
 - As of June 2013, A2S2 financed contracts for 36 metric tons of artemisinin, approaching the project goal of 40 metric tons. However, only 22% of contracted volume was delivered, with a maximum additional 41% projected to be delivered after project close. The undelivered volume was lost mainly to adverse weather conditions and failure of production partners to deliver on contracts with the extractors.
 - Though less artemisinin was delivered than expected, in the four-year lifetime of the A2S2 project the artemisinin market did not experience a shortage of artemisinin to meet global ACT needs.
 - By June 2013, the majority (73%) of funds disbursed by the pre-financing facility had been repaid. Whether and when the remaining \$1,537,240 will be repaid remains unclear. The funds that were not repaid during the project lifetime are owed by extractors whose crops failed in the year financed.

Management: *Low*

- Management of the A2S2 project saw challenges throughout the course of the project, particularly in the areas of speedy, responsive decision-making and of early alignment on roles, responsibilities, and expectations.

Impact & Sustainability: *Low-medium*

- In a positive unintended impact, A2S2 contributed to increased market diversification by supporting the survival and growth of the then-fragile East Africa / Madagascar artemisinin industry.
- However, the sustainability of the project’s intended impact remains uncertain due to lack of financing to continue market intelligence efforts, difficulties securing replacement working capital lenders, and continued supply volatility in the market.

Recommendations for future projects

UNITAID addresses vexing problems across the global health space, and stakeholders deem it appropriate and aligned with its mission that UNITAID is willing to experiment with new and innovative project designs that entail a high degree of uncertainty. A2S2 is one such project, addressing the extreme supply volatility in the artemisinin market. If UNITAID continues to pursue innovative projects in challenging markets with many unknowns, a subset of these experiments will fail to deliver their intended impact. The true impact of UNITAID’s work as a funder willing to take risks to tackle difficult problems can only be measured across the portfolio of similar projects. As these projects explore novel

approaches in uncharted territory, constant learning from their challenges and adaptation based on these lessons are required for success.

UNITAID can learn from each of A2S2's two interventions. Experience with the market intelligence program showed that the success of a market intelligence program depends on willingness to divulge information, which varies based on market conditions and how accessible the released information will be. Experience with the pre-financing facility showed that, when operating in a high-risk market, UNITAID should expect that a single production cycle may not be enough time to show results. Additionally, in some situations, UNITAID could consider offering a form of non-debt finance.

In addition to lessons on intervention design, A2S2 yielded experience suggesting that all partners should recognize that these types of projects with greater uncertainties might require a different structure and *modus operandi* when it comes to management. Project design should recognize that many events that will change the calculus on project objectives and activities cannot be foreseen and planned for *ex-ante*.

Consequently, short feedback loops and adaptive ability are required in the project design itself. When projects have clear processes that call on all parties to observe and discuss what works and what does not during the course of the project as well as decision-making structures that allow the project to change in response to these observations, challenges over the course of the project can be quickly addressed and learned from experientially. In order for this to work, all partners must be willing to change course if needed as well as be flexible and capable enough to do so. Choosing partners with these capacities and exercising them in UNITAID's project oversight will be important to the success of future innovative projects. UNITAID's own accountability to its Board limits its flexibility, and developing ways of responsively managing projects within these limitations is also key to future success.

Conclusion

The evaluation has shown that the A2S2 project had positive impacts on the artemisinin market despite challenges that prevented targets from being met within the original timeline. The introduction of semi-synthetic artemisinin to the market will significantly affect cycles of supply, potentially eliminating the need for further intervention in the market. The effect of semi-synthetic artemisinin's introduction to the market will depend on the amount produced, uptake, and coordination among market actors: it would be difficult to develop a well-informed design for further intervention in the market before that effect is known.

The A2S2 project also yielded valuable lessons for UNITAID, which grew and formalized as an organization over the course of the project's lifetime. As UNITAID continues to pursue innovative interventions in nascent and/or volatile markets, findings relevant to how the A2S2 project was designed and executed can inform the success of future work.

1 Theory of Change

The A2S2 Project intervened in the market for artemisinin in order to ensure that sufficient ACTs would be available to meet global malaria needs, an impact that could be achieved sustainably through the stabilization of the artemisinin market. The best ways in which to address the root causes of the artemisinin market’s volatility are unknown, and consequently A2S2 established two directly achievable target outcomes that addressed clear needs in the market. Progress toward these outcomes can be measured through a series of output metrics, and was made through the activities undertaken by the Project Management Group.

The overall logic behind the A2S2 project’s design can be explained in a Theory of Change. Dalberg created the following Theory of Change based on project documentation, including the 2009 Project Plan and the June 2013 version of the Final Report, to illustrate the linkages between activities and outputs as a means to test and learn from this initiative (see Figure A).¹ As a whole, the Theory of Change explains how each activity the implementing partners undertook over the course of the project contributed to outcomes that would impact beneficiaries. When available from project outset, Theories of Change guide a project by ensuring that the activities undertaken ultimately contribute to desired outcomes and impact.

Figure A: Theory of Change for A2S2 project

Impact	Availability of sufficient ACTs to meet global malaria need	
Outcomes	Stable supply of artemisinin at fair prices	
	Prevent immediate shortage in 2011 by increasing artemisinin supply by 40 MT	Improve the consistency and predictability of artemisinin supply through increased market transparency and development of a more formally structured market
Outputs	<ul style="list-style-type: none"> • Number and \$ value of loans extended • % repayment rate of each loan and portfolio • Number of MT of artemisinin contracted • Number of MT of artemisinin delivered • Number of artemisinin suppliers kept in or added to the market 	<ul style="list-style-type: none"> • Number of market actors supplied with projected artemisinin supply levels / production at a global, regional, and country level • Number of purchases shifted from the spot contracts to formal contracts
Activities	<ul style="list-style-type: none"> • Establish and manage a revolving finance facility for artemisinin extractors • Extend loans to artemisinin extractors, allowing them to offer financing to Artemisia producers to increase plantings 	<ul style="list-style-type: none"> • Collect and share market information useful to farmers planning their production and extractors planning their investment • Facilitate longer-term contracts and relationships between ACT manufacturers and extractors

¹ Section 5.1 of the 2009 Project Plan includes an expanded list of highly specific “Project Actions and Outcomes.” This Theory of Change consolidates these into the activities listed.

2 Introduction

In 2009, the Assured Artemisinin Supply System (A2S2) project was created with financial support from UNITAID to secure the supply of artemisinin – the essential pharmaceutical ingredient for artemisinin based combination therapies (ACTs). Since 2001, when the World Health Organization (WHO) recommended ACTs as first line treatment for uncomplicated malaria, the market for artemisinin has experienced significant volatility. Between 2003 and 2008 the number of countries that have adopted ACTs in their national policies increased from less than 20 to 77, representing all malaria epidemic countries except French Guiana, Guatemala and Haiti.² Forecasts during that period anticipated a rapid expansion of demand for ACTs.

Significant investment made to scale-up cultivation of *Artemisia annua*, the herb used to derive artemisinin, was unmet by demand for artemisinin from ACT manufacturers. Oversupply in 2007 forced many artemisinin extractors and producers out of the market and farmers to plant alternative crops. Liquidation of stocks from previous years created a significant drop in artemisinin prices, from over USD 1,100/kg in 2006 to below USD 200/kg in 2007.³ As a result, market observers believed that insufficient levels of *Artemisia annua* were being planted during the 2008 season to meet global demand.

According to estimates, less than 5,000 hectares of *Artemisia annua* were planted in 2008, down from 28,000 hectares in 2006 and 14,500 in 2007.⁴ Overstock of artemisinin was believed to be sufficient to satisfy demand for refined artemisinin in 2009. However, decreased cultivation caused concern as the time required from planting to extraction is 12- 16 months.⁵ Industry experts calculated that nearly 28,000 hectares of *Artemisia annua* would need to be planted in 2009 to replenish stocks and meet ACT manufacturer demand in 2010.⁶ Projections at this time lead many to believe that the market for refined artemisinin would be undersupplied by as much as 40 metric tons, or the equivalent of 80 million ACT treatments in the coming years.⁷

The challenge of ensuring sustainable artemisinin production and the risks presented by a potential shortage were the focus of discussion at the Artemisinin Forum hosted by the Medicines for Malaria Venture (MMV) and the WHO in November 2008. In response to these discussions, the A2S2 project was created with funding from UNITAID and guidance from, among others, the WHO, the Roll Back Malaria Partnership (RBM) Secretariat and Médecins Sans Frontières (MSF).

With the ultimate aim of reversing the ongoing contraction in the artemisinin supply chain and increasing plantings in 2010 and 2011, UNITAID agreed to provide USD 9.3 million to finance the revolving finance facility and related project activities of the A2S2 project for a two year period from July 2009 to June 2011. The A2S2 Project Management Group - comprised of i+solutions, Artepal, FSC Development Services (FSC), and Triodos Investment Management (Triodos) - was given a dual mandate for the project:

² WHO, "World Malaria Report 2009", 2009

³ "A2S2 Project Plan", July 2009

⁴ Artepal, "Artemisinin Market Situation and the Need of a Financial Support Mechanism," 29 March 2009

⁵ A2S2, "Production Cycle: from Artemisia to ACT," 05 March 2010

⁶ Artepal, "Artemisinin Market Situation and the Need of a Financial Support Mechanism," 29 March 2009

⁷ Estimates varied, but 40 metric tons was envisioned as sufficient to fill the anticipated gap; "A2S2 Project Plan", July 2009

- 1 to provide a revolving finance facility for artemisinin extractors supplying eligible ACT suppliers and intermediaries, and
- 2 to provide market intelligence on the artemisinin supply situation, enhancing transparency and market-responsiveness.

Security of artemisinin supply was considered essential to supporting the efforts of the global health community to control malaria. Financing from the A2S2 project was intended to bridge the gap between supply and demand in 2010 and 2011. Market intelligence from the project would contribute to a stable supply of artemisinin at fair prices.

2.1 Context

In 2008 significant uncertainty in the future supply of artemisinin led UNITAID to create the A2S2 project, following recommendations coming out of the Guilin Artemisinin conference to create a financial mechanism to support artemisinin extractors. The project required the coordinated effort of four implementing partners - i+solutions, Artepall, FSC, and Triodos. The project was tasked with increasing plantings of artemisinin to ensure supply for ACT production in 2010 and 2011.

Achieving this objective required efforts in two areas. First, A2S2 would provide financing to artemisinin extractors through a fund set up by UNITAID. Pre-financing from A2S2 would allow extractors to purchase additional stocks of *Artemisia annua* from farmers and increase production of refined artemisinin. Loans were to be repaid after production and delivery of the artemisinin. This revolving fund is known as the A2S2 pre-financing facility. The second area of focus involved providing increased knowledge of the supply and demand of artemisinin to key stakeholders through site visits with artemisinin extractors and ACT manufacturers. It was envisioned that this information would be disseminated to the public through an online portal known as the "A2S2 Dashboard."

The A2S2 project was implemented by i+solutions, a non-profit organization specialized in pharmaceutical supply chain management in developing countries. As lead organization, i+solutions was responsible for ongoing project implementation and operational management with the support of the other members of the Project Management Group. i+solutions was responsible for coordinating the market intelligence activities undertaken by Artepall and FSC. Additional responsibilities included managing information collection and dissemination to stakeholders outside the project, the promotion of fair pricing through publication of current market rates, and project reporting to UNITAID.

Artepall and FSC were responsible for compiling market intelligence through site visits with artemisinin extractors and ACT manufacturers. Their responsibilities included identifying eligible artemisinin extractors for the pre-financing facility and monitoring artemisinin supply and inventory levels throughout the supply chain.

Triodos managed the A2S2 pre-financing facility. Loans associated with the A2S2 project were made through an account within the Triodos Sustainable Trading fund at the sole discretion of Triodos. As manager of the fund, Triodos was responsible for analysis of loan applications, approval, disbursements, monitoring, and financial reporting.

The Project Management Group received ongoing technical support and advice from a Project Advisory Group composed of representatives from the WHO, the RBM Secretariat and MSF. This group provided an advisory and monitoring function to the project and an independent source of knowledge and expertise to the management team.

The project was initially intended to launch during the first quarter of 2009, but was delayed during the finalization of agreements between the implementation partners and UNITAID. The A2S2 project was officially launched in July 2009 when a memorandum of understanding was signed between UNTAID and i+solutions and funds to sustain the project were transferred to i+solutions.

In January 2011, the UNITAID Secretariat initiated a midterm review that was conducted by Dalberg Global Development Advisors. The review assessed the progress of the project to date and identified opportunities for improvements, which were shared with UNITAID.

2.2 Objectives of the review

In 2013, the UNITAID Secretariat initiated a final review to assess the progress of the A2S2 project over the course of its lifetime. Dalberg Global Development Advisors, an international development consultancy, was selected to complete this review through a competitive bidding process. The objectives of this independent evaluation are threefold:

- to assess the extent to which the project has achieved the agreed objectives
- to assess how project management has contributed to achieve the project objectives more effectively and efficiently, and
- to recommend ways in which lessons from the project could be used to inform future UNITAID projects.

This report is structured to reflect these objectives. The sections that follow summarize the methodology of this evaluation, present key findings on the progress of the Second line HIV/AIDs project, and provide recommendations on how UNITAID can learn from the project.

3 Findings

This section presents the key findings of the final review of the A2S2 project. As with any market-shaping project, there are a number of challenges to assessing the efficacy of market interventions. For example, there are a host of external factors that could have influenced a market result, project activities can be difficult to disentangle from these external factors.

The artemisinin market is not a closed system, and other factors influenced the market besides A2S2's intervention. The pre-financing facility tried to increase successful cultivation of Artemisia and extraction of artemisinin, an outcome that can be heavily affected by weather, technical failures, and even changes in local financing availability.

Another set of factors influencing the market in ways that make attribution to the pre-financing facility difficult is the actions of other major market influencers. For example, A2S2 cannot affect demand for

artemisinin and ACTs, which is heavily influenced by the Global Fund. As another example, the potential first producer of semi-synthetic artemisinin was a player whose actions were outside the reach of A2S2’s direct influence. These actions, however, had deep influence on supply levels: the prospect of SSA introduction greatly affected growers’ and extractors’ production decisions.

Attribution of changes in market transparency to the A2S2 market intelligence program were complicated by concurrent demand forecasting efforts (also funded by UNITAID) and the effects of annual artemisinin conferences. The BCG/CHAI/MIT-Zaragoza demand forecasting project supplied complementary market intelligence to that provided by A2S2, using some of A2S2’s market intelligence as an input. Since this intervention occurred at the same time as A2S2, the balance of attribution across the two interventions cannot be pinpointed. Additionally, annual artemisinin conferences in which A2S2 representatives participated and which were of high market intelligence value, were not technically part of A2S2, but contributed to the same outcomes within the market.

The findings have been organized into four categories: relevance, effectiveness and efficiency, impact and sustainability; and management. Figure 1 below presents a high-level summary of key the findings and review ratings for each of these categories. The activities and outcomes noted in the theory of change are evaluated in the “Efficiency & Effectiveness” section, and the overall market impact in “Impact & Sustainability” section.

Figure 1: Summary of findings

	Rating	Outcome 1: Prevent immediate shortage in 2011 by increasing artemisinin supply by 40 MT	Outcome 2: Improve the consistency and predictability of artemisinin supply through increased market transparency and development of a more formally structured market
Relevance	✓ High/medium	<ul style="list-style-type: none"> + Need for innovative/experimental approaches to stabilization + Need among artemisinin extractors for working capital to finance producers 	<ul style="list-style-type: none"> + Need for innovative/experimental approaches to stabilization + Need for greater market transparency - Not clear to what extent lack of transparency drove supply volatility
Efficiency & Effectiveness	○ Low/medium	<ul style="list-style-type: none"> - Contracts for 36 MT were financed (target was 40 MT) - Only 7.9 MT of financed volume was delivered by June 2013 - Ultimate cost-efficiency dependent on loan repayment + Additional 8 MT facilitated, though not directly financed 	<ul style="list-style-type: none"> + Increased market transparency at end of project - Market intelligence not accessible/useful for majority of project lifetime
Management	✘ Low	<ul style="list-style-type: none"> - More speedy and responsive decision-making was necessary to respond to changing market conditions - Misaligned expectations on roles led to implementer overstep - Implementing partners did not have expertise to cover the full range of activities they were asked to perform 	<ul style="list-style-type: none"> - Misaligned expectations around responsibilities led to delayed dissemination of useful information - Implementing partners did not have expertise to cover the full range of activities they were asked to perform
Impact & Sustainability	○ Low/medium	<ul style="list-style-type: none"> + Delivered volume contributed to global supply in years when production was sufficient to meet global demand + Increased market diversification - Difficulties securing replacement working capital lenders 	<ul style="list-style-type: none"> + More informed decision-making among market actors + Continued appetite for market intelligence - Mechanism and funding for future market intelligence sharing unclear

3.1 Relevance

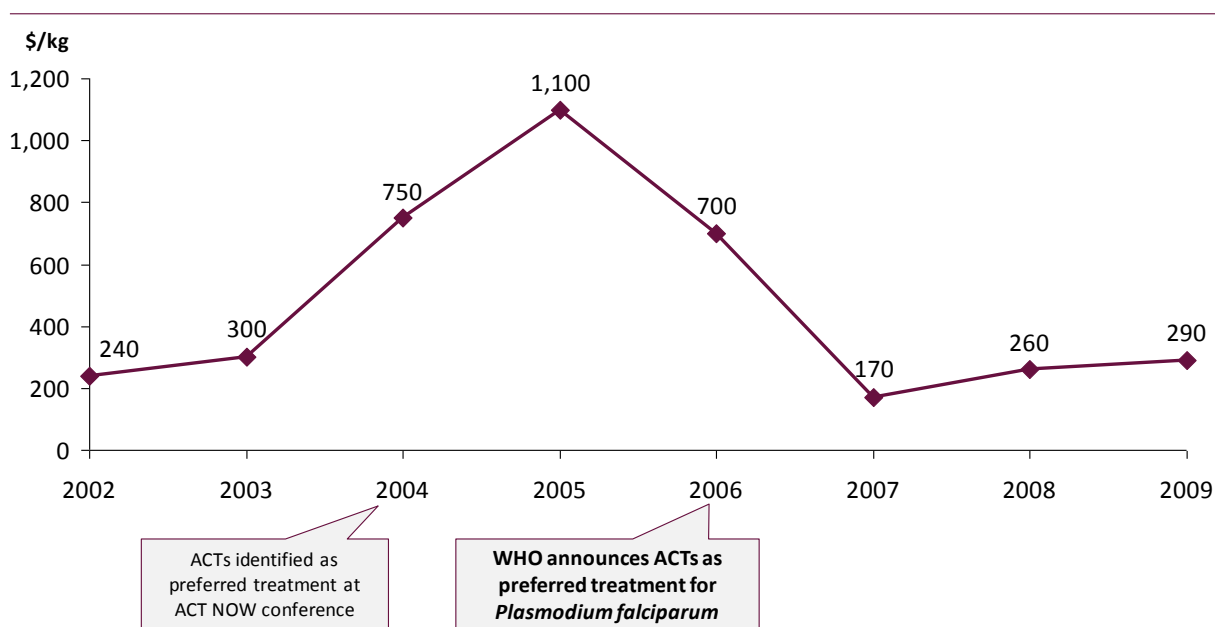
Final review rating: **High-Medium**⁸

A2S2 was a highly relevant intervention because at the time of project design, the artemisinin market was experiencing extreme levels of supply and price volatility. The root causes of this volatility were unclear, and there was a need to experiment in order to mitigate it. In choosing to address two clear areas of need within the market, UNITAID was able to test whether addressing these needs would contribute to supply stabilization at fair prices. Both the pre-financing facility and the market intelligence program were relatively low-cost, novel interventions that addressed evident needs within the market and could be attempted without putting an undue level of resources on the line.

3.1.1 Artemisinin market was in need of innovative approaches to supply stabilization

At the time of project proposal, the artemisinin market was experiencing extreme volatility in both supply and price, which justified concern that without intervention a supply shortage could occur that would deny treatment to patients in need of ACTs. After the WHO announced ACTs as the preferred treatment for *Plasmodium falciparum* malaria in 2006, oversupply in 2007 forced many artemisinin extractors and producers out of the market and incentivized farmers to plant alternative crops. Liquidation of stocks from previous years caused artemisinin prices to plummet (see Figure 2). This state of the market offered no assurance that enough *Artemisia annua* would be planted in future years to meet global ACT need.

Figure 2: Price history of artemisinin through 2009 (indicative spot price, \$/kg)



Source: A2S2 presentation at 2010 Artemisinin Conference: "Artemisinin Market Quantities and Pricing"; Dalberg analysis

⁸ Findings constitute a combined qualitative and quantitative assessment of the different areas under review. They represent a summary of evaluator's views. A "high" rating indicates that all or most goals in an area have been achieved; a "medium" rating indicates that a significant portion of goals has been achieved, but that some important gaps exist. A "low" rating indicates that the majority of goals in an area has not been achieved.

Even in the 2007-2009 period, when year-to-year changes in price were much smaller than in previous years, changes in price were still bigger in year-on-year percentage terms. Price increased 52.9% from 2007 to 2008, and 11.5% from 2008 to 2009.

Additionally, when the A2S2 project was initiated, the introduction of semi-synthetic artemisinin (SSA) was not yet imminent enough to address forecasted supply needs. Ultimately, Sanofi did not achieve WHO prequalification for its SSA until May 2013, at the end of the project's extended lifetime. Based on interviews, though it was known in 2009 that SSA could eventually be introduced, delays in bringing it to market could be and were expected. Even if SSA had been introduced earlier, it was in no way certain that its introduction would have a stabilization effect – the consideration that SSA could merely transfer volatility from one part of the market to another could have made A2S2 relevant even in a scenario where SSA was expected to be introduced during the project lifetime.

4.1.2 Artemisinin extractors lacked sufficient options to finance increased production

The artemisinin extractors financed by the pre-financing facility lacked comparable financing options that would have allowed them to begin production in the years financed. “Had A2S2 not existed, we would not be here today,” claimed one loan recipient. Another explained that had the A2S2 loan not been available, his company's facilities would have sat idle – as they had for the last two years due to price instability. Local banks saw the volatility of the artemisinin market as a source of high risk, and would not extend financing for the production and extraction of artemisinin.

That the pre-finance facility served a need in the market was also indicated by the number of extractors interested in receiving a loan from the facility, which was more than the facility was ultimately able to finance. One extractor that did receive a loan was strongly interested in additional financing later in the program, after A2S2 had resolved not to issue further loans. Had comparable financing options been available to these extractors, interest in A2S2 would not have been as high.

4.1.3 Artemisinin extractors lacked insight into global production levels to inform planning

Before A2S2's efforts, extractors around the world lacked an organized source of market information that would allow them to plan production for the next year based on carefully compiled forecasts. When A2S2 was established, the artemisinin market was still nascent, with few players at the extractor level and only occasional conferences to provide any structure for the sharing of information.⁹ Even at the conferences, the information shared depended on what each presenter had access to and was able to compile: A2S2 filled a gap by undertaking coordinated collection of information about supply levels and other information relevant to informing decision-making among extractors.

3.2 Effectiveness and Efficiency

*Final review rating: **Low-Medium***

A2S2 successfully completed all planned and approved activities on budget, though the timelines for lending and producing useful market information were challenged. The effectiveness and efficiency of these activities were mixed overall. On the negative side, outputs from the pre-financing facility in terms of the loans themselves and the artemisinin contracted and delivered fell short of project target, but in

⁹ The November 2008 Artemisinin Conference in Guilin, China, at which A2S2 was envisioned followed a 2007 Artemisinin Conference in Bangkok.

an unanticipated positive effect of the pre-financing facility, two extractors operating in regions new to artemisinin production were kept in the market. Aside from timeline issues, the effectiveness of market transparency and formalization was positive: A2S2 successfully provided a large number of market actors with market intelligence and shifted several purchases from spot contracts to formal contracts. These efforts respectively contributed to greater market transparency and contributed in a limited way to the development of a more formally structured market.

4.2.1 Pre-financing facility successfully established

A2S2 successfully established a pre-financing facility that issued loans to artemisinin extractors. It did so over the course of two no-cost extensions. The project did not exceed the total approved envelope of \$9,280,400, though \$363,000 to pay i+solutions' for market intelligence activities during the second extension needed to be transferred from funds originally intended for the pre-finance facility.

3.2.2 Contracted and delivered volume financed fell short of the 40 MT target

Through the pre-finance facility, 36MT of artemisinin were ultimately contracted across four loans to extractors based in China, Vietnam, Madagascar, and Mauritius. This was the result of dedicated sourcing efforts on the part of both FSC and Artepal. The extractor based in Vietnam sourced from Kenyan producers in addition to Vietnamese-produced supply; the supply of the Mauritius-based extractor was also based in East Africa.

Of the contracted volume, only 7.9 metric tons was delivered by June 2013. As of that date, i+solutions expected an additional 14.7 MT to be delivered after project close, but the delivery of this volume remains uncertain. A May 2013 visit by Malcolm Cutler and Jacques Pilloy concluded that all aspects are in place to ensure the production and delivery of the contracted volumes. This conclusion was based on observations that: (i) Bionexx has enough dry *Artemisia* leaf and intermediate artemisinin "paste" to fill present orders, (ii) in addition, intermediate material that could not be fully extracted last season has been returned from a remote facility for final extraction, (iii) local purification capacity is established and expanding.

Elysian Life Services has initiated direct farming on three sites in Kenya, which i+solutions projects will generate approximately 50% of the undelivered volume. Other corrective actions being taken by ELS include shifting production from small to medium-sized farmers and taking measures to prevent disease such as the bacterial infections caused by heavy rains in the 2012 season. Despite these measures, there is no certainty that additional tonnage from Bionexx and ELS will be delivered.

The 13.4 MT contracted but not expected to be delivered was lost due to cyclones in Vietnam that destroyed fields, failure to deliver by Vietnamese farmers bound by contracts, and an increase in the cost of *Artemisia annua* in China that led to side-selling of leaf by farmers supplying Beijing Gingko Group and financial difficulties resulting from the collapse of a few of BGG's key Japanese clients after the March 2011 earthquake.

3.2.3 Loans concentrated in different regions than anticipated

Unanticipated changes in national regulatory environment caused a shift in the geographic distribution of loans away from China to extractors in East Africa and Madagascar. In 2009, after project start, the Chinese authorities reinterpreted their lending regulations in a way that effectively prevented Chinese enterprises from accepting a loan from an overseas institution. This made direct lending agreements

between Triodos and artemisinin extractors and/or manufacturers legally impossible. This caused less tonnage to be contracted than anticipated for two reasons First, most producers are in China, so being unable to lend directly in China significantly reduced the number of candidates for loans (see Figure 3).

Figure 3: Artemisinin produced by country, 2012 (MT)

Artemisinin production by country, 2012 (MT)



Notes: (1) 40MT of semi-synthetic artemisinin projected but not all will be available for usage in 2013
 Source: A2S2.org; Dalberg analysis

Second, at the time of financing, extractors in East Africa and Madagascar had a higher risk profile and significantly less capacity than did the Chinese extractors to which the project had planned to loan. While this shift had a positive effect on market diversity, it significantly reduced the volume that the project was able to finance.

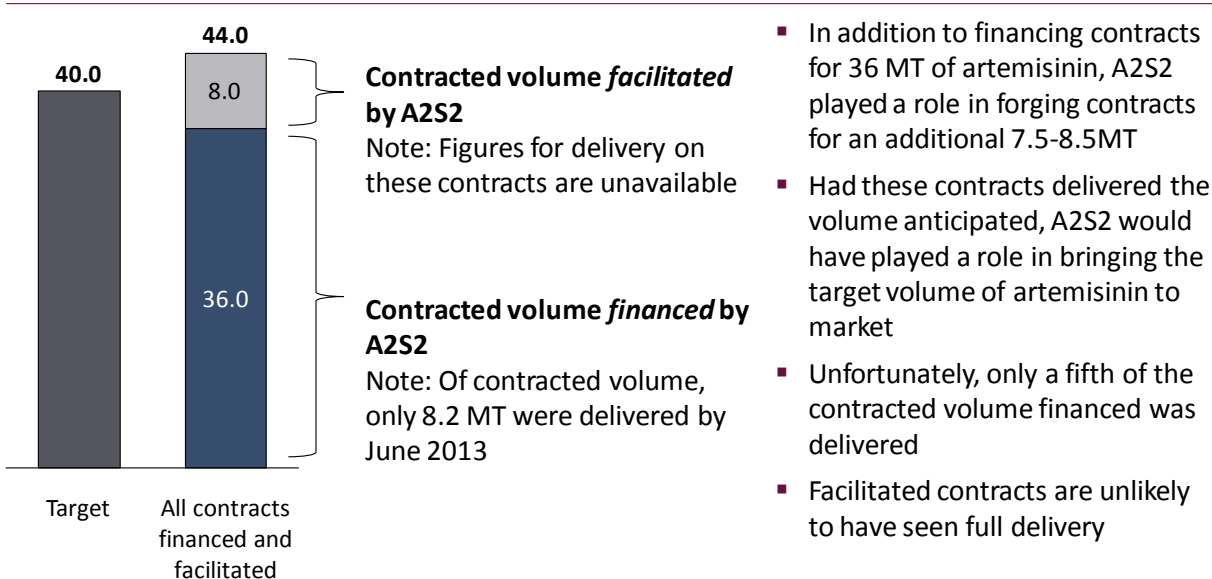
3.2.4 Indirect facilitation of additional volume

The A2S2 team facilitated the contract of additional volume that was not financed through the pre-financing facility. Without the A2S2 team’s efforts, two extractors’ supply might not have reached approved ACT producers: A2S2 provided the connection that ensured that the volume would contribute to approved supply.

In the first case, A2S2 intervened to assist Vietnamese extractor Mediplantex, in signing a longer-term contract in January/February 2011 for 6MT with an Indian ACT Producer. The extractor had previously only sold on the “spot” market without a contract. In A2S2 put a second Vietnamese extractor, Hung Thinh, in direct contact with ACT producers for 1-2MT. Following A2S2’s introductions, Hung Thinh signed a supply agreement with an approved ACT manufacturer for the first time – previously, it had only sold through traders. Without A2S2’s intervention this volume could still have contributed to supply if approved ACT manufacturers bought it on the “spot” market or through traders. However, it could also have been bought by not-approved ACT manufacturers and failed to contribute to supply.

In a third case, A2S2 helped to develop direct longer-term contracts between an Indian ACT producer and an extractor in Uganda. This contract was for 0.5MT.

Figure 4: Artemisinin financed and facilitated by A2S2 (MT)



Source: A2S2 Final Report; Dalberg analysis

Overall, the A2S2 team reports that contracts for 7.5-8.5MT additional to the volume financed were forged through its support. Had all of the contracts that A2S2 financed and facilitated delivered fully on their contracted volume, the amount of additional tonnage brought to market either directly or indirectly by the A2S2 project would have exceeded the target of 40MT. Unfortunately, only 22.8% or 8.2 MT of the volume financed by A2S2 was delivered by June 2013. It is unlikely that facilitated contracts saw full delivery, since they were located in Vietnam, where delivery on A2S2-financed loans was lessened by a cold spring and severe cyclones. However, documentation of the facilitated loans' delivery rates was not available at the time of the final review.

3.2.5 Loans not paid back on time

None of the four loans was paid back during the expected time-frame. No loan was paid back in full by the end of the first no-cost extension, and only one loan was paid back in full by the end of the second no-cost extension. Interviews suggest that a second loan was paid back summer 2013. The expected repayment dates for the remaining two loans are 1 January and 1 February 2014, though whether and when these two loans will be repaid remains highly uncertain. Due to the structure of the loans, which are not secured by collateral, loan recipients face few material consequences to late payment or non-payment, though either could place their reputations within the artemisinin community at risk.

As of June 2013, \$1,537,240 in loan principal remained to be paid back to the A2S2 facility. Vedic in Vietnam owed \$110,396, Bionexx in Madagascar owed \$297,164, and Elysian Life Services in Mauritius owed \$1,129,680. This put repayment levels at 100% for Beijing Ginkgo Group, 91% for Vedic, 75.2% for Bionexx, and 13.1% for ELS. Overall, 73.2% of the disbursed funds had been repaid by June 2013. The portfolio as a whole earned \$374,495 in interest by June 2013. Triodos planned to charge extractors 1-month Euribor or Libor² +5%, which it estimated at approximately 6%, which would be below market level. Though terms varied by loan, extractors reported paying approximately 6.5%.

3.2.6 Challenges with timing

From a timing perspective, this project was challenged. The original project timeline did not afford enough lead time or flexibility to overcome unforeseen delays that occurred throughout the project.

Firstly, the original timeline of the project did not allow for as long a lead time as ended up being necessary. As a result, start-up was delayed and A2S2 missed the start of the Asian planting season. The project was initially intended to launch during the first quarter of 2009, which would have allowed A2S2 to finance Artemisia production in Asia in 2009 that would have increased the artemisinin supply in 2010. However, the finalization of agreements between implementation partners and UNITAID delayed the start of the project until July 2009, after the start of the 2009 Asian planting season. At the start of the project, 85-90% of global artemisinin output was in Asia (China and Vietnam), with the effect that missing the Asian planting season left A2S2 fewer options for financing in 2009. The time lost in the up-to six month delay at from Q1 2009 to July 2009 was added on to the end of the project in the first no-cost extension, which lasted from July through December 2011. While one could argue that the delay in start-up inhibited the project's ability to reach the 40 MT goal, that adding on as much loan-sourcing time as was lost still did not enable the project to meet the goal suggests that missing the initial harvest cycle was not the determining factor for volume.

Secondly, the two no-cost extensions of the A2S2 project were enacted because the initially planned timeline of the project allowed for little flexibility relative to the harvest cycle. The timeline of the project relative to the harvest cycle meant that the pre-financing facility could not make a single loan covering multiple harvest cycles in the same region. This made the project sensitive to natural agricultural risks such as year-to-year variability of yields due to weather, which delayed recipients' abilities to pay back their loans. One extractor responded to adverse weather that wiped out production in Vietnam by planting in Kenya later that year in hopes of filling the same contract. However, even this loan was not fully repaid by the end of the second extension.

Finally, coordination with implementing partners and UNITAID's standard approvals process were sources of unforeseen delay throughout the project, with impact on the ability to finance the targeted volume within the available timeframe. At least one 10MT contract in China had to be cancelled due to signing delays.¹⁰

3.2.7 Necessary market intelligence relationships established and field visits conducted

FSC and Artepal established necessary relationships for market intelligence collection. By the time of the midterm review, A2S2 had visited 18 artemisinin extractors and 6 ACT manufacturers. Further trips were undertaken in 2011 and 2012 to visit a range of extractors and producers in Vietnam, China, Kenya and Uganda.

FSC and Artepal made a combined 24 regional visits to East Africa, China and Vietnam, India, London, France, the UK, and Switzerland from August 2009 to May 2013 to meet with artemisinin extractors and ACT producers. This figure includes due diligence visits to loan recipients but does not include visits to conferences in China, India, Spain, Madagascar, Switzerland, Germany, and Vietnam.

3.2.8 Market intelligence information disseminated publicly and semi-privately, after initial delays

¹⁰ A2S2 Phase 2 Proposal: Annex 1.

A2S2 established a public website to disseminate artemisinin market information. However, initially the utility of the website was hampered by limits on what information could be made public and only during the project extensions did A2S begin to publish and distribute market intelligence information that was of great use to artemisinin extractors. With one exception, interviewed extractors did assert that the market intelligence they received from A2S2 was useful in planning and making decisions about production in the coming year.

For most of the project's lifetime, the program was unable to distribute sufficient relevant information due to FSC and Artepál's concerns about confidentiality. Parties were not initially aligned on what information FSC/Artepál needed to provide under the project's terms and how best to protect FSC/Artepál's relationships with market actors while producing useful information. Though the 2009 Project Plan called for public distribution of market intelligence through the A2S2 website 'dashboard', it also instructed that: "Only after obtaining consent from the concerned companies, solutions will publish information in the public domain i.e. through the dedicated web site ('dashboard')." This tension between the requirement for consent and the goal of making market information publicly available was thus present from project start.

These confidentiality concerns were resolved only through much back-and-forth between UNITAID and the implementing partners. At the start of the first no-cost extension in July 2011, A2S2 issued the first of four online newsletters to members of the artemisinin community. Through the newsletter, A2S2 was able to strike an agreeable balance between confidentiality and utility.

The newsletter was initially sent to around 400 stakeholders, a list that grew to around 500 by the end of the project. Interviews suggest that these newsletters were considered helpful but extractors tended to still take advantage of the ability to contract FSC and Artepál directly. A survey distributed in the fourth and final newsletter intended to assess its utility to readers only saw a 1-1.5% response rate.

The newsletter was developed within the original market intelligence budget. The market intelligence program did not overrun its original budget until the second extension, which required the transfer of \$363,000 from funds allotted to the pre-financing facility, to cover the cost of extended market intelligence activities. The updated A2S2 website, which aggregated information in a way that sufficiently protected anonymity at the company level, was launched in November 2012 and was regularly updated through the end of the project.

3.3 Impact and sustainability

Final review rating: Low-Medium

As an innovative intervention in a unique and volatile market, A2S2 had an occasionally positive and at least net neutral impact on the market in all areas it impacted, even where targets were not met.

A2S2 implemented innovative interventions in an attempt to shape the artemisinin market while it was still nascent and highly volatile, and the market improved in several ways over the course of the project. These improvements occurred in-line with the objectives A2S2 sought to bring about through its intervention.

Through its market intelligence program, A2S2 served as a catalyst for improvement in market transparency by acting as a hub for communication about and association around artemisinin production. Additionally, the loans that A2S2 made, when considered in absolute rather than against

original targets, had only positive impact on their recipients' ability to finance a season of artemisinin cultivation. The loans that performed least well financially had the greatest impact on the continued cultivation of *Artemisia annua*, bolstering the African region's artemisinin industry in a way that prevented the market from being over-concentration in Asia, which would raise the risk of supply shortages caused by regional or seasonal weather events. It is clear from this review that though A2S2 may not have reached all of its targets or potential, what impact it did have was positive, and efforts were made toward making this impact sustainable.

5.3.1 Positive impact of market intelligence

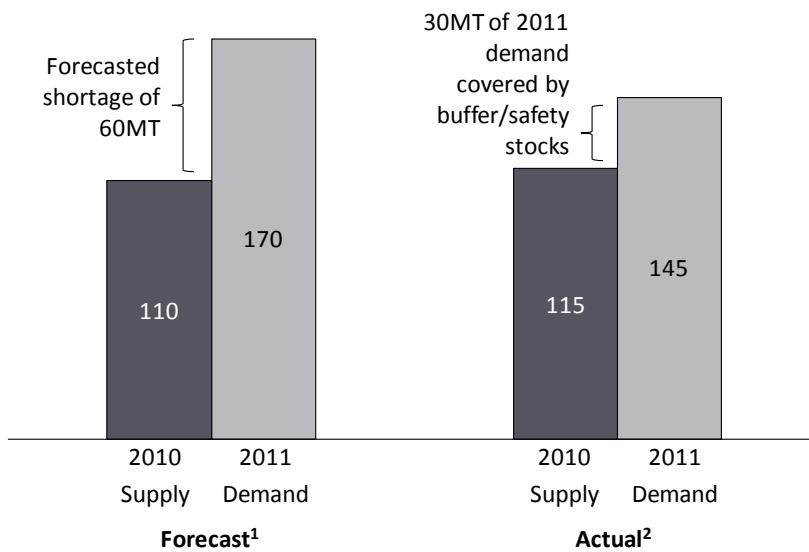
The majority of interviewed extractors asserted that the market intelligence they received from A2S2 directly from FSC and Artepál, through the newsletter, and through the website was helpful in informing their decision-making. One extractor described how, based on information from FSC and Artepál, her business chose to change how much they planted based on the forecasted balance of production and demand for the coming year. Though the number of newsletter recipients who responded to the survey about the newsletter was small, it is worth noting that all of the six responses were positive, and five were maximally so.

In a highly volatile market where the prospective introduction of semi-synthetic artemisinin has been a source of uncertainty, the availability of regional and global supply estimates, as well as other data such as yield and processing efficiencies, allowed extractors to professionalize their operations by planning based on an understanding of both global and regional supply forecasts. The community created through the collection and dissemination of these data further contributed to the professionalism in the market to the point that extractors have called for the creation of an artemisinin association. Several stakeholders interviewed mentioned in particular that Artepál's efforts to integrate Chinese extractors into a global community around the market – and related efforts to make available information about Chinese production – were particularly helpful to industry stakeholders outside of China.

3.3.2 Effects of targeted and delivered volume

In the four year lifetime of the A2S2 project, the artemisinin market did not experience a shortage of artemisinin to meet global ACT needs. Hindsight shows that, though the 40MT estimated at the start of the project to be necessary to prevent a shortage in the 2010/2011 season were not needed to satisfy demand, demand did exceed 2010 production by 30MT, which were taken from buffer/safety stocks.

Figure 5: Artemisinin market 2010/2011 (MT)



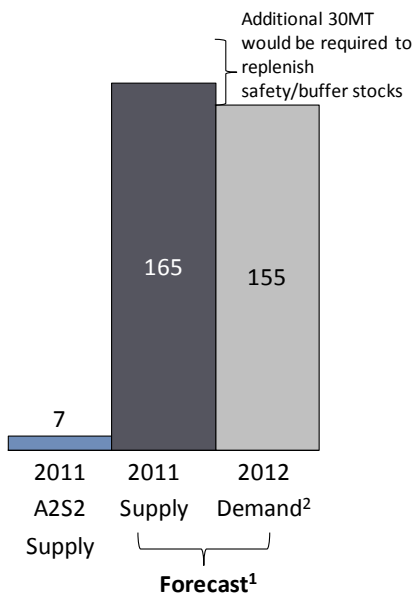
- In 2011, less of the artemisinin needed to meet global demand had to be taken from buffer/safety stocks than was predicted midway through 2011
- A2S2’s loan to Bionexx was issued in time for the 2010 African planting season, but that contract yielded only 0.67MT in volume, with no significant effect on global supply

Notes: (1) Forecast in July 2011 A2S2 newsletter; (2) As reported in October 2011 A2S2 newsletter
 Source: A2S2 Newsletters

The following year, 2011 artemisinin supply was sufficient to both meet 2012 demand and partially replenish the safety/buffer stocks depleted by 2011 demand (see Figure 5). There was no shortage in 2011, and certainly no need for the 40MT originally targeted in the A2S2 Project Plan. The 6.6MT produced by contracts A2S2 disbursed in time for the 2011 planting seasons comprised approximately 4% of the year’s supply, in a year when production was sufficient to meet global demand.

Figure 2: Artemisinin market 2011/2012 (MT)¹¹

¹¹ A2S2 Supply is compared to 2011 Supply / 2012 Demand forecasts in absence of reported actual figures for those years in A2S2 project documentation.



- Artemisinin supply in 2011 was sufficient to meet 2012 demand and partially replenish safety/buffer stocks depleted to supplement 2010 supply
- The original 40MT goal set at project start was no longer necessary by the 2011/2012 season; in fact, an additional 40MT produced in 2011 would have constituted a supply surfeit that could discourage production the following year
- A2S2 financed two contracts in time for the 2011 planting season: one in China and one in Vietnam and Kenya
- Together, these contracts delivered under 7MT of artemisinin, of the year's approximately 165MT supply

Notes: (1) Forecast in October 2011 A2S2 newsletter. A2S2 supply compared to forecast figures used in place of actual figures due to the absence of reported actual figures for 2011 Supply and 2012 Demand in A2S2 project documentation; (2) Does not include 30MT replenishment of safety stocks
Source: A2S2 Newsletter; 2011 Artemisinin Conference materials

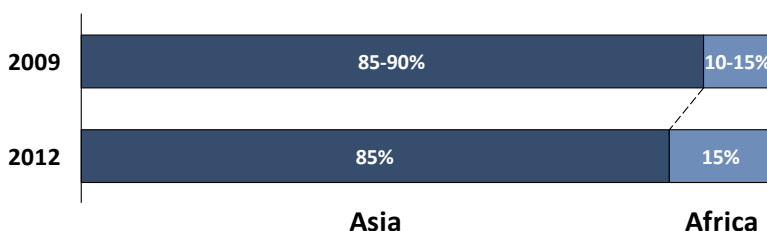
4.3.3 Increased diversification in the global market

A2S2's lending efforts kept a number of artemisinin extractors and growers from outside China in business over the course of the project. Without A2S2's intervention, these extractors would have failed to produce any artemisinin during the project lifetime, further concentrating global production in China. The market diversification preserved by their survival is an important safeguard against the supply risks inherent in the concentration of production in one country. A market in which supply is entirely based in Asia would be more susceptible to regionally limited shocks such as weather and national economic conditions.

According to i+solutions, at the time of project start, China and Vietnam accounted for roughly 85-90% of global artemisinin output. A2S2's latest market intelligence figures show Asia's percentage of natural artemisinin production to be 85%, showing that no diversity was lost over the course of the project (see Figure 6). Several interviewees acknowledged that without A2S2's lending efforts, individual extractors supporting entire regional production in Africa would have been without the working capital needed to finance the season and stay in the business of artemisinin production.

Figure 6: Natural artemisinin production by country, 2009-2012 (% total natural production)

Natural artemisinin production by country, 2009-2012 (% total natural production)



- i+solutions estimates that in 2009, roughly 85-90% of global artemisinin output was produced in Asia (China and Vietnam)
- 2012 production figures show that this balance was maintained
- If Bionexx in Madagascar were to produce to full capacity (40MT), Africa's share of natural production could rise to 21%

Source: A2S2 Final Report; A2S2.org; Dalberg analysis

In addition to maintaining the percentage of artemisinin produced outside of China, the working capital loan afforded at least one recipient the financial stability to increase extraction capacity beyond the levels represented in the 2012 figures.

Although it is too early to see what effects this diversification has on the market in the long run, supply sustainability is one of the overall market dynamics goals of the A2S2 project, and the survival of the African artemisinin extraction industry is a necessary precursor to its sustainable growth.

3.3.4 Designing for sustainability

A2S2 made noted efforts toward ensuring the sustainability of the project's impacts by attempting to help extractors line up funders for future seasons and by seeking funding for continuation of the market intelligence efforts. The former effort saw some success when meetings between Bionexx and local banks had successful outcomes, with the support of A2S2 market intelligence advisors. However, this one success came despite persistent challenges in making the case for artemisinin financing to traditional banks.

Ultimately, A2S2 was designed as a project that would be implemented and concluded within a limited timeline: A2S2 would enter and then exit the market. Though the pre-financing facility was designed to be sustainable by receiving back funds through loan repayment, UNITAID did not end up seeking to "recycle" the pre-financing facility funds. With both the pre-financing facility activities and the market intelligence program activities, there could be no sustainability without open-ended UNITAID involvement and funding. In terms of impact, the market intelligence program will only have a lasting impact if its work is replicated. The pre-financing facility will not have a lasting impact on artemisinin supply or market stabilization – it is unclear how a one-time supply increase was intended to contribute to sustainable market stabilization – but its indirect impact of preserving geographic diversity in the market during a time when it was threatened, may have the longest-term effects within the market.

3.4 Management

Final review rating: Low

Despite strong commitment from all parties to the success of the project, A2S2 experienced management and coordination difficulties throughout its lifetime, including through the two no-cost extensions. Both UNITAID and i+solutions acknowledge that communication could have been improved, and that better alignment of expectation could have prevented misunderstandings.

4.4.1 Selection and activities of implementing partners

Though they completed all required activities, some of the implementing partners did not have expertise covering the full range of activities they were asked to perform.

As A2S2's lead implementing partner, i+solutions was responsible for managing the activities of the other three implementing partners. Interviews suggested that i+solutions developed functional working relationships with Triodos, FSC, and Artepai, and that these relationships were maintained throughout the project. i+solutions submitted scheduled project progress reports on time, and when asked for specific information to supplement planned periodic reporting, i+solutions responded in sufficient detail to satisfy the request. However, i+solutions did not come into the project with experience with artemisinin extractors, despite being asked to manage an intervention where the beneficiaries were artemisinin extractors.

The team's market knowledge was instead concentrated in FSC and Artepai. FSC and Artepai were well-established within the artemisinin market and had strong relationships with many of the existing artemisinin extractors as well as the credibility to establish new relationships, including in China. FSC and Artepai also had enough working familiarity with artemisinin production and extraction to be able to collect valuable information via field visits; however, they had limited experience that would qualify them to source loan deals from a perspective of risk management and mitigation.

Triodos is a full-fledged bank with a history of professionalism that correctly implied the technical capacity to establish and maintain the pre-financing facility. Multiple loan recipients mentioned that fund manager Koert Jansen managed to be both supportive and diligent in exerting the appropriate pressure to keep to the revised repayment schedule. Like i+solutions, Triodos lacked experience with artemisinin extractors and, differently than i+solutions, with the entire artemisinin market.

The proposal for A2S2 came to UNITAID with all implementing partners (i+solutions, Triodos, FSC, and Artepai) already chosen. As a result, UNITAID did not have the opportunity to define the qualifications it saw as necessary to manage and implement the project. The suitability of each partner for its role consequently cannot be evaluated against any documented requirements. Absent the opportunity to compare against initial criteria, *post-hoc* analysis considers relevant qualities of partners that were evident at the time of the proposal. Based on this analysis UNITAID could in future lending projects seek project managers that combine both the market knowledge and risk sensitivity necessary to serve as gatekeepers of access to UNITAID funds lent through any financing facility.

4.4.2 Need for speedy, responsive decision-making to respond to changing market conditions

Planning and managing a market shaping initiative is challenging. Markets are dynamic and complex, featuring multiple actors, influencers and unanticipated events. As a result, it is imperative that the organizations that fund and manage market shaping initiatives rigorously monitor how conditions are evolving, act quickly to adapt to changing circumstances, and effectively coordinate among one another to implement those changes. These short feedback loops will allow for real-time improvements in response to project setbacks. Both of the key parties involved in the A2S2 project learned important lessons in this area. Due to a range of factors, communication about major changes (e.g., the challenges of lending in China) did not occur as effectively, resulting in slower decision making and inefficiencies in implementation.

4.4.3 Earlier alignment on roles, responsibilities, and risk anticipation

Though the MoU defined roles and responsibilities of the project management group, these written descriptions ended up not being able to take the place of interpersonal efforts toward alignment from the beginning of the project. In at least one instance, when Triodos and i+solutions extended loans beyond the planned end-date of the project without prior upward consultation with UNITAID, perceptions of partners' responsibilities were misaligned, with i+solutions reading the MoU's reference to potential lending beyond the time of completion as a grant of authority rather than a description of a contingency that would need to be considered jointly with UNITAID.

As the project changed course in response to changes in on-the-ground circumstances, the risks it needed to anticipate changed as well. When anticipating lending to better-established Chinese extractors in the 2009 Project Plan, Triodos anticipated "an annual loan loss around 2%," caveating, "Actual losses may be higher or lower depending on the performance of the individual loans."¹² However, the 2009 Project Plan was approved before lending shifted to higher risk extractors in Africa. A2S2 would have benefitted by efforts from both sides to anticipating how African extractors' different level of capacity and experience would affect risk of delayed payment or default.

The project would also have benefitted from earlier anticipation of the risk that few extractors or producers would feel comfortable divulging information to be published on the public A2S2 website's 'dashboard.' More in-depth discussions at project start around how to respond to this risk may have accelerated the process by which UNITAID, FSC, and Artepál eventually did arrive at a compromise solution in which FSC and Artepál protected their clients' confidentiality while providing UNITAID with useful information for publication.

4 Lessons learned and Recommendations for design of future initiatives

This document is a final evaluation of the A2S2 project, and as such its purpose is not to direct the course of the A2S2 project, which has concluded, but rather to inform future efforts by enabling UNITAID to learn from its attempt to shape the artemisinin market. This section attempts to distill insights from the document's findings, which can inform the future design and implementation of market-shaping mechanisms.

The section provides lessons learned and recommendations that are relevant to the design of future interventions of a similar type (i.e. market intelligence programs and financial facilities), as well as recommendations relevant to the management of any future market intervention. These recommendations are based on the experience of A2S2, but intended to be widely applicable.

4.1 Market intelligence

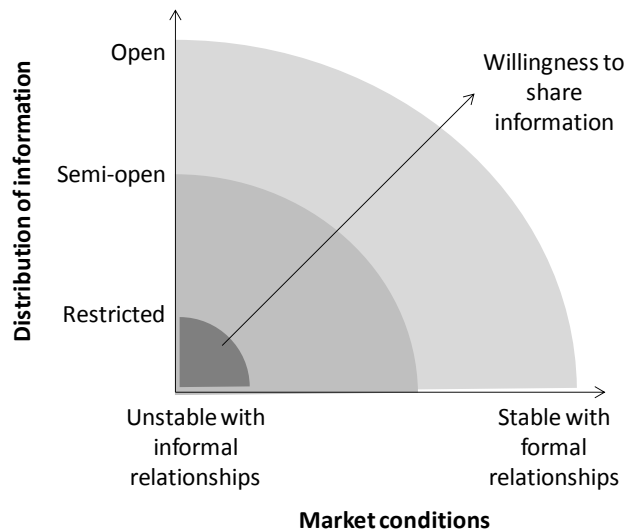
The A2S2 project yielded lessons that will be useful to consider during the design and implementation of future market intelligence projects.

4.1.1 Structure market intelligence programs in accordance with market stage

The success of a market intelligence program depends on the willingness of market participants to divulge information. That willingness depends on market conditions, trustworthiness of those collecting data and on how information will be shared.

¹² A2S2 Project Plan, Section 2.1.5-15

Figure 1: Degrees of willingness to share market intelligence



In unstable markets, such as agricultural markets with long production times that make them sensitive to volatility, information sharing is personal and unorganized: individuals share directly with other individuals based on comfort built on informal personal relationships. This effectively restricts access to information, which is shared under conditions of interpersonal confidence. A third-party “hub” for information can open access to information slightly more by consolidating and anonymizing, provided they still maintain personal, trusting relationships with both sources and recipients of information and exercise discretion with regards to confidentiality. (This is the state in which A2S2 found the artemisinin market, where FSC and Artepal already acted as information “hubs.”) While in an unstable market characterized by informal relationships, one is likely to find few actors willing to divulge information for open distribution, actors in stable markets with formal relationships are more likely to provide information for open distribution.

When planning future market intelligence projects, the market’s stage of development should inform how the project is designed: public availability of all information may be appropriate in a well-established market, but in a less-developed market, it will hinder the collection of information. Flexibility in platform design can be a key to navigating willingness to share information: a platform that allows those who submit information to control to what degree it is accessible can adapt to existing and even changing market conditions.

4.2 Pre-financing facility

The pre-financing facility is widely considered to be the more innovative part of A2S2. It was also the higher-risk undertaking, and, as such, offered much to learn.

4.2.1 Allow for a longer timeline to better judge efficacy of the intervention

When designing an innovation in a riskier market with greater uncertainty, longer timelines can be needed to verify the efficacy of the intervention, especially if the number of actors affecting the outcome is small. With only four loans extended, each for the term of one crop cycle, the fact that all four extractors had a bad season that year and were unable to deliver fully or repay within the original project timeframe could indicate that a pre-financing facility was not an effective intervention or it could be an unfortunate coincidence.

Had the fund been able to lend to many more than four extractors, an outcome in which all had a concurrent bad year would be less likely. Lending to more recipients would have increased sample size, making it easier to draw a conclusion. But without enough loan recipients to make coincidental concurrence highly unlikely, it is difficult to tell whether or not the intervention would have had different outcomes with different loan recipients or in a different year. Extending the timeline allows the project to distinguish between “these recipients” and “this year” when determining what drives the outcome. In the case where the year’s weather and market conditions were at fault, extra time would also afford unlucky-but-worthy recipients a better chance of repaying the loan.

In the future, when operating in a high-risk market, UNITAID should expect that a single production cycle may not be enough time to show results: in this case, delivering artemisinin volume and paying off the loan. Risk can be mitigated by extending timelines over several production cycles to give actors involved more time to overcome unpredictable challenges such as production-diminishing natural disasters. Additionally, some recipients that would be impactful to support may not be in situations that are appropriate for debt finance; in these situations UNITAID could consider some other form of non-debt finance.-

4.3 Managing a market intervention

In addition to learning from the design of market intelligence and supply-augmenting interventions, UNITAID can learn from how A2S2 was designed and managed as a whole.

4.3.1 Plan for change, particularly in innovative and “high risk” projects

Particularly in innovative and “high risk” situations, it is beneficial both to have concrete goals and also a process by which the plan to achieve those goals can change in response to changing circumstances.

At the start of an intervention, a Theory of Change can benefit both UNITAID and its implementing partners by providing a framework through which to communicate and align on a shared understanding of how activities undertaken by the implementing partners will ultimately bring about the impact that UNITAID intends to have. When UNITAID plays a role in designing the projects, jointly developing a Theory of Change can enrich the process of project design. Where projects have been designed ahead of time, UNITAID could see the beginning of the project as an opportunity to either request a Theory of Change or jointly develop one with project implementers.

As the project plan is designed, UNITAID should build in mechanisms to revisit and revise the Theory of Change and its implied activities in response to changes on in project circumstances. This is particularly important to the success of innovative projects with high levels of risk, such as A2S2. When project circumstances are likely to change, projects can be guided by a clear goal of the intended impact to achieve and adapt supporting objectives and activities as needed over the course of the project. Innovative market interventions can be highly beneficial and should continue to be undertaken when

appropriate, provided they are balanced with more tested approaches across the UNITAID project portfolio.

4.3.2 Choose partners that complement UNITAID's strengths

The success of UNITAID's projects depends in great part on the partners chosen to implement them. In general, UNITAID needs partners that can perform the project management role while strongly communicating upward. When projects are new, experimental, or high risk, implementing partners must also have demonstrated ability to adapt and be flexible, including by employing a flexible structure for rapid internal and joint/collaborative decision-making. The partners must also be able to come to UNITAID ready to justify the changes they seek by communicating their effect on the ultimate impact of the project.

5 Conclusion

The evaluation has shown that the A2S2 project had positive impacts on the artemisinin market despite challenges that prevented targets from being met within the original timeline. The introduction of semi-synthetic artemisinin to the market will significantly affect cycles of supply, potentially eliminating the need for further intervention in the market.

The A2S2 project also yielded valuable lessons for UNITAID, which grew and formalized as an organization over the course of the project's lifetime. As UNITAID continues to pursue innovative interventions in nascent and/or volatile markets, findings relevant to how the A2S2 project was designed and executed can inform the success of future work.