Teaching Educators about Sustainable Development:

Developing an Effective Series of Informational Brochures and Educational Videos on Wood Vinegar, Biofertilizers, and Biogas

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Sponsor: The Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects

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Abstract

The Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects has implemented several sustainable development projects at educational demonstration sites throughout Thailand that use environmentally friendly practices to minimize the depletion of resources. This organization seeks to disseminate these innovative practices to educators who visit the demonstration sites from neighboring Asian countries. To learn how to spread this knowledge, the project team conducted questionnaires and interviews about the success of one of the demonstration sites located at the Na Yao schools. As a result, the team developed informational brochures and educational videos in both Thai and in English on the wood vinegar, biofertilizers and biogas practices that can be distributed to the educators who visit demonstration sites with these projects. These media will help open effective channels of information distribution and teach educators who visit these sites about the benefits of sustainable development and self-reliance.

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Executive Summary

The appealing informational brochures and educational videos developed through the completion of this project help address the problem of disseminating knowledge on sustainable development initiatives at educational demonstration sites throughout Thailand to educators visiting from remote rural areas. At these demonstration sites, educators seek to gain knowledge that can be used to enhance their own curricula and reinforce the education of their youth with practical hands-on projects. These projects teach useful skills that increase students' capacities for success after graduation.

Extensive research at a demonstration site in a rural village called Na Yao, which is sponsored by the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects, led to the tailoring of eight informational brochures and six educational videos to a target audience of educators visiting the demonstration site. These media promote and facilitate the spread of beneficial agricultural practices. Specifically, these practices include the production of wood vinegar, biofertilizers, and biogas. These media capture the audience with the positive impacts of sustainable development by placing their benefits in the context of specific projects. To complement these benefits, the media convey the feasibility of each project through the inclusion of an easy to understand, step-by-step procedure.

This report describes the process of tailoring the informational brochures and educational videos to the target audience. It lays a foundation for the development of media that can effectively convey a message across cultural barriers by synthesizing academic research on the design of media with active research at the educational demonstration site in Na Yao. Interested parties can easily adapt this process to similar applications and learn from the team's successes and difficulties during the data collection and media development.

During their research, the team carefully identified the intended message of the media and determined four important themes on the benefits of sustainable development to convey. These media concentrate on transferring self-reliance through a focus on project procedure, conveying the projects' abilities to educate youth through hands-on participation, demonstrating the projects' abilities to improve quality of life, and promoting environmental awareness. The team triangulated the identification of these themes with data from multiple methods, including an interview with representatives from the Office of H.R.H., active participation with students

and teachers in the wood vinegar, biofertilizers and biogas projects at the demonstration site, student questionnaires, and an interview with a successfully self-reliant farmer in the surrounding community.

Another success of this project lies in the creation of media that is not only specific to a target audience, but also versatile. The team designed two sets of media, one in Thai and one in English, which can be used to accommodate educators with a range backgrounds and language proficiencies. For the creation of brochures, careful consideration was given to the accurate translation of content and to differences in design elements between Thai and English brochures. The team accomplished this by comparing a range of existing Thai and English brochures and identifying commonalities and differences in categories such as type, layout, shape, font, and color. The final media were designed based on this knowledge to maximize positive reception among the target audience.

For educational videos, the team studied the interplay between visual and auditory modes of learning, paying close attention to factors such as structure, shot choice, shot length, and verbal instruction. Within these categories, the team identified the importance of preparing the viewer for instruction by emphasizing project benefits, providing the viewer with repetition to reinforce concepts, and supplementing verbal instruction with text and helpful visual aids. To add to the sophistication of these videos, the project team used modern 3-D technology to demonstrate the construction processes, and recorded all of the audio in a studio with a high-sensitivity microphone. Ultimately, the videos and brochures reinforce and complement each other, but can also stand alone to provide the educators who view them with accurate and helpful information.

The findings of this report were used to tailor this project to the sponsor's requests and develop an effective series of media. These informational brochures and educational videos can be used to disseminate information on the wood vinegar, biofertilizers and biogas projects to educators who visit the Na Yao schools and similar demonstration sites throughout Thailand. The project team hopes that these media will be used at other demonstration sites and will inspire educators to implement their own sustainable development projects.

Access to Educational Videos

The project team's educational videos are all available online. The final product can be found on the links below.

English Wood Vinegar Video:

http://www.youtube.com/watch?v=NhSmTPdDvAM

Thai Wood Vinegar Video:

http://www.youtube.com/watch?v=CStBguYwpd4

English Biofertilizers Video:

http://www.youtube.com/watch?v=zQvkT0vQdZ0

Thai Biofertilizers Video:

http://www.youtube.com/watch?v=898YeGsUITg

English Biogas Video:

http://www.youtube.com/watch?v=X1fOA2qyXgA

Thai Biogas Video:

http://www.youtube.com/watch?v=0syoMKQrxAM

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1. Introduction

According to the World Bank (2010), the rapid development and expansion of industrial activity over the last three decades has negatively impacted Thai ecosystems. Innovative sustainable practices need to spread across the country to minimize this destruction. Environmentalists have started to grasp the gravity of this problem and are suggesting that governing authorities implement rules and regulations to prevent these negative effects. Emerging non-profit organizations have become the voice of sustainable practices in several areas of the world. For example, according to the United Nations Development Programme (2010), the Thai government revised its constitution in 2006 to mandate improved environmental governance. As a result, the National Economic and Social Development Board (2006) developed a plan to promote "green and happiness in society" and became committed to encouraging sustainable development and self-reliance (p. 8). Additionally, Thailand introduced requirements for a Health Impact Assessment (HIA). Based on research by environmental scientist Cheunchit (2009), the HIA required that the framework and design of all new Thai development be assessed prior to construction. According to these plans, Cheunchit believes that all new developments must facilitate enabling environments and encourage sustainable practices. In turn, the Thai people have the opportunity to live more independently in a healthier world. For example, the World Bank (2010) recognized that when the Thai government recently decided to phase out leaded gasoline, it resulted in reduced ambient levels of lead. Decisions like this need to be spread throughout other parts of Asia. However, it is not always straightforward to transfer policies into practices. Potential users of sustainable development need guidelines for implementing their own projects.

The Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects is another organization that promotes projects related to sustainability throughout Thailand, especially in remote rural areas. According to social researchers Bird, Moore and Shepherd (2002), the quality of life in these areas is often limited by access to natural resources, education, communication, and opportunities. The Office of Her Royal Highness recognizes these factors and focuses its efforts on educating the youth about sustainability and self-reliance through practical, hands-on projects. For example, schools in the rural Thai community of Na Yao, located in the Cha

Choeng Sao Province, have benefitted from the sponsorship of the Office of H.R.H. and are now being used as a demonstration site for educators visiting from other remote areas of Asia. The sustainable development projects in the schools have improved the quality of life at the Na Yao demonstration sites and could continue to do so at other schools. However, these demonstration sites are limited in their ability to spread their innovative practices and curriculum to other schools in Thailand and Asia. To realize the benefits of sustainable development, educators who are interested in using these practices must be inspired and learn the implementation strategies. This will allow them to take a step towards achieving a sustainable and self-sufficient lifestyle.

In order to further promote the adoption of sustainable practices in remote areas of Asia, several key issues must be addressed. The project team researched how to identify and convey the benefits of sustainable development in an appealing manner so that individuals will want to implement these practices. For implementation to take place, the procedures of the practices must be communicated in a way that is easy to access and understand. The project team concentrated their efforts on the wood vinegar, biofertilizers and biogas projects at the Na Yao schools. The objective of the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects is to use the success of these three particular projects as examples for educators who visit the site and are interested in adopting similar sustainable practices.

This project bridges the gap in information between those who practice sustainable development and those who are looking to implement these practices at their own schools. The team researched the benefits and procedures for making wood vinegar, biofertilizers and biogas and identified the important aspects of each project to convey to the educators. The team investigated how to best disseminate this information to educators in order to convey the benefits that these projects can have on a community. They followed a set of guidelines for designing media and developed a series of criteria for each of their designs. This information helped the project team develop an effective series of informational brochures and educational videos to be shown to educators who visit the Na Yao schools and similar demonstration sites throughout Thailand.

In order to develop these two forms of media, the project team used interviews, questionnaires and participatory methods to identify trends in dissemination and determine the desired message of the media. The team gathered contextual and project-related information in

order to develop and assess an effective series of informational brochures and educational videos that appeal to teachers who visit the educational demonstration sites in Thailand. These media will promote sustainable development and aid in the transfer of self-reliance, benefit the students educationally, improve the community's quality of life and increase environmental awareness. The synthesis of the information that the project team gathered opens effective channels of information distribution that will disseminate knowledge on sustainable development to educators from other remote areas of Asia who visit the demonstration sites in Thailand.

Report Overview

Each chapter of this report describes the steps that the project team took to design their informational media. The report can be used as a guideline for those who develop media in the future. In Chapter 2, the project team provides background information in order to define the role of sustainable development in a community and learn how to disseminate it to educators in an appealing manner. This chapter provides readers with an understanding of the topics that the team is addressing and the factors to consider when developing media.

Chapter 3 determines the message of the informational media based on the requests of the Office of H.R.H. and the empirical research performed in Na Yao. By determining the message, the project team identified the goal of the media and determined how to design the brochures and videos so that they can meet the project goal.

In Chapter 4, the project team explains the guidelines that they followed for developing their informational brochures and educational videos. The project team did this in order to follow a plan that has resulted in the successful development of media in the past.

Chapter 5 describes how the team used each phase from these guidelines to develop their informational brochures. These brochures are one form of media that will help disseminate sustainable practices like wood vinegar, biofertilizers and biogas to teachers who visit the Thai demonstration sites.

Chapter 6 continues to follow these guidelines for the development of educational videos in order to explain the teams design process. The team did this to demonstrate the success they experienced from following a perfected plan. Like the brochures, the intent of these videos is to help spread sustainable practices like wood vinegar, biofertilizers and biogas to educators.

Finally, Chapter 7 describes the conclusions that the team reached upon the completion of their project. These claims synthesize the results that the project team learned when developing informational media and will provide future teams who are designing media with some suggestions.

2. Literature Review: Synthesizing Sustainable Development with Developing Media

The Thai government and the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects have worked to spread education throughout Thailand in order to benefit the underprivileged people in the country. Economist Eduardo P. Garrovillas (2005) claims that a "government's ability to provide quality education for its people is crucial not only to its survival but also to its ability to compete in the global market and be a meaningful partner in world affairs" (p. 373). In order to compete in the global market, the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects has created several educational demonstration sites throughout Thailand for educators from neighboring countries to visit and learn from (Office of H.R.H., Personal Communication, January 18, 2011).

The use of informational brochures and educational videos can spread education on sustainable living and self-reliance throughout Asia. They can help teach educators who visit these demonstration sites about the benefits of including these projects in their schools' curricula. This background chapter provides detailed information on the advent of sustainable development, its goals and outcomes, its progression in Thailand, and the necessary frameworks of understanding for disseminating sustainable practices.

2.1 Sustainable Development: Social Impacts and Support

Sustainable development has gradually increased in prevalence as a development model because of the significant improvements it can make in a community. The Brundtland Commission (1987) defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" ("Towards Sustainable Development," para. 1). The Commission argues that a better standard of living can be achieved by supporting economic and social development while preserving the environment and its natural resources, and emphasizing the concept of societal needs. According to Pearce (1993) in his book *Blueprint 3: Measuring Sustainable Development*, some broad outcomes of successful sustainable development include improvements in education, health, and other quality of life measures.

In Thailand, government policy and non-government organizations have worked to increase such outcomes of sustainable development. In 2006, the 10th National Economic and Social Development Plan for 2007-2011 (NESDP) encouraged the spread of innovative practices

in order to promote the implementation of sustainable development and the idea of self-reliance (National Economic and Social Development Plan, 2006). The United Nations Educational, Scientific and Cultural Organization (UNESCO) is a non-government organization that works to spread sustainability as well. UNESCO is an international organization that deals with the "building of peace, the eradication of poverty, sustainable development and intercultural dialogue through education, the sciences, culture, communication and information" (UNESCO, 2010). Her Royal Highness Princess Maha Chakri Sirindhorn of Thailand was designated the UNESCO Goodwill Ambassador for the Empowerment of Minority Children and the Preservation of their Intangible Cultural Heritage in March of 2005, in recognition of her "outstanding commitment to education and to the welfare of children in remote areas" (UNESCO, 2009).

As a result, the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects has taken the UNESCO and NESDP plans seriously and is looking for recommendations on how to promote existing sustainable practices amongst the youth of Thailand. As part of these efforts, UNESCO and the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects are involved in over seven hundred demonstration sites throughout Thailand. These sites serve as experienced models for both the surrounding community and visiting delegations looking for examples of successful development initiatives (UNESCO, 2011). The ultimate aim of these sites is to further a mission surrounding education for sustainable development (Office of H.R.H., Personal Communication, January 18, 2011; UNESCO, 2011).

One of these demonstration sites is located at two schools in Na Yao, a remote rural community 160 kilometers east of Bangkok near Cambodia. Her Royal Highness Princess Maha Chakri Sirindhorn was inspired to work in Na Yao after seeing how her parents, His Majesty the King and Her Majesty the Queen, improved this rural community based on the concept of H.M. the King's "Sufficiency Economy." According to Thailand's National Economic and Social Development Board (2004), this philosophy recommends that development begin with ensuring that "the majority of [a] population has enough to live on" (p. 1). The Na Yao schools take H.M. the King's Sufficiency Plan seriously by teaching students the importance of providing for themselves in order to become productive members of society.

2.2 The Na Yao Schools as a Demonstration Site for Sustainable Development

Two schools in Na Yao, the Ban Na Isan Border Patrol Police School and Phrarachathan Secondary School, share a curriculum that promotes the philosophy of self-reliance, which can be shared with educators in similar remote areas of Asia. The Na Yao village is located in the Cha Choeng Sao Province, as shown in Figure 1 below.

Figure 1: A map of Bangkok and the Na Yao village, which is near the Cambodian border.

According to conservationist Gilbert (1983), the use of a demonstration site like Na Yao can create a "model for regions facing similar problems" by showing "the successful application of appropriate technologies to specific problems" (p. 34). In his paper *Disseminating Success for All: Lessons for Policy and Practice*, Slavin (1999), an education expert from Johns Hopkins University, extends this statement to include the transfer of curricula by asserting that, "the best way for new schools to obtain the 'attainable vision' of what a [curriculum] should look like and be able to accomplish is to arrange to have staff members from new schools visit experienced schools" (p. 18). In Na Yao, the demonstration schools are experienced in an education that emphasizes science and math as well as a vocational aspect that increases students' capacity for continued success (Office of H.R.H, 2011). Based on the research of Alexander, Israel, Lax, Lohaphansomboon, Saxner, and Srisawasdi (2010), one component of this vocational aspect

stresses agriculture, which is the main source of income for many of the Na Yao community members and a significant economic player in many rural and remote areas of Thailand. UNESCO and neighboring governments send educators from remote areas of their countries to learn about the sustainable agricultural practices of the Na Yao schools. This example of education for sustainable development is a small part of UNESCO's goal (2011) of "engaging people in negotiating a sustainable future, making decisions, and acting on them" ("Characteristics of ESD," para. 1).

Visiting educators can benefit from detailed knowledge on three practical examples of appropriate technology for sustainable development taking place in the Na Yao schools: wood vinegar, biofertilizers and biogas. Wood vinegar is produced in an airless kiln. It creates charcoal for cooking and a liquid that can be used as a safe and effective pesticide and fertilizer (Global Healing Center, 2010). Biofertilizers are created with the use of soil micro-organisms and organic materials such as fruits and vegetables. Biotechnologist Bunders (1990) claims that biofertilizers can be applied at the base of most plants to increase their nutrient uptake and replenish the soil without the use of harmful chemical fertilizers. Scientist Chan (2009) explains that biogas is a domestic energy source that is produced using manure and waste from livestock and crop residues. The Na Yao secondary school uses biogas for cooking school lunch, which reduces reliance on traditional fuel sources by twenty five percent each month (Office of H.R.H., Personal Communication, January 18, 2011).

Students at the Na Yao demonstration site have directly experienced the benefits of these projects, which are integrated into their overall learning experience and improve their quality of life. For example, agriculture at the school aids in the on-site production of food for school lunches (Office of H.R.H., 2011). All three of these projects represent components of a practical education for self-reliance and sustainable living, which is beneficial in remote communities like Na Yao, where agriculture is a primary source of income (Alexander et. al., 2010). These practices can be spread throughout areas of Asia that have similar environments as the Na Yao demonstration site. These similar environments have access to the same resources as the Na Yao demonstration site, which makes the projects easier to transfer.

2.3 Disseminating the Knowledge of the Na Yao Demonstration Sites through Informational Media

Informational brochures and educational videos can be used to supplement existing demonstrations at the Na Yao schools by providing instruction on the wood vinegar, biofertilizers and biogas projects to the target audience. This section examines the different means of effectively disseminating knowledge on sustainable development through informational media and how to use that media to inspire change. This information helps guide the development of media on the three sustainable development projects.

2.3.1 Top-Down and Bottom-Up Dissemination at a Demonstration Site: Frameworks for Positively Influencing Visitors

By developing a clearly outlined message through a top-down method, informational media can transfer knowledge to the message-receiver. Communication professionals Dozier and Ehling (1992) define top-down dissemination as a type of dissemination that spreads knowledge from organizations and administrators to individuals. The Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects wishes to provide informational brochures and educational videos to educators who visit the Na Yao schools, with the hopes that they can successfully transfer sustainable development projects to their home institutions. Robertson (1967), a Ph.D. and specialist in the diffusion of innovation, claims that messages communicated in a top-down manner have proved to be effective at conveying knowledge. However, he, among others such as communication scholar Klapper (1960), also acknowledges that top-down dissemination is less effective at changing attitudes and behavior. Understanding a bottom-up communication framework can lead to strategies for addressing this weakness by providing a sense of how different dissemination patterns can work together at a demonstration site.

Understanding how bottom-up communication might work at a demonstration site can inform the design of effective media by creating more opportunities to change attitudes and behavior. A bottom-up approach starts the dissemination of information with individuals, who spread an idea through a community, normally via informal participation or interpersonal communication. According to UNESCO (2011), the philosophy of the approach of the royally-initiated schools "is to use the school as a center of learning for the community" ("Formal Education," para. 2). Research by Dozier and Ehling (1992) advocates an interpersonal message rather than a mass media message for trying to influence this type of communication. However,

while Robertson (1967) states that using an interpersonal message has proven to be effective at changing attitudes and behavior, Balit (2007), a scholar of communication for development, argues that effecting change with interpersonal communication requires highly trained individuals, more resources, and more time than mass media. Figure 2 below depicts both the top-down and bottom-up channels of information dissemination at a demonstration site.

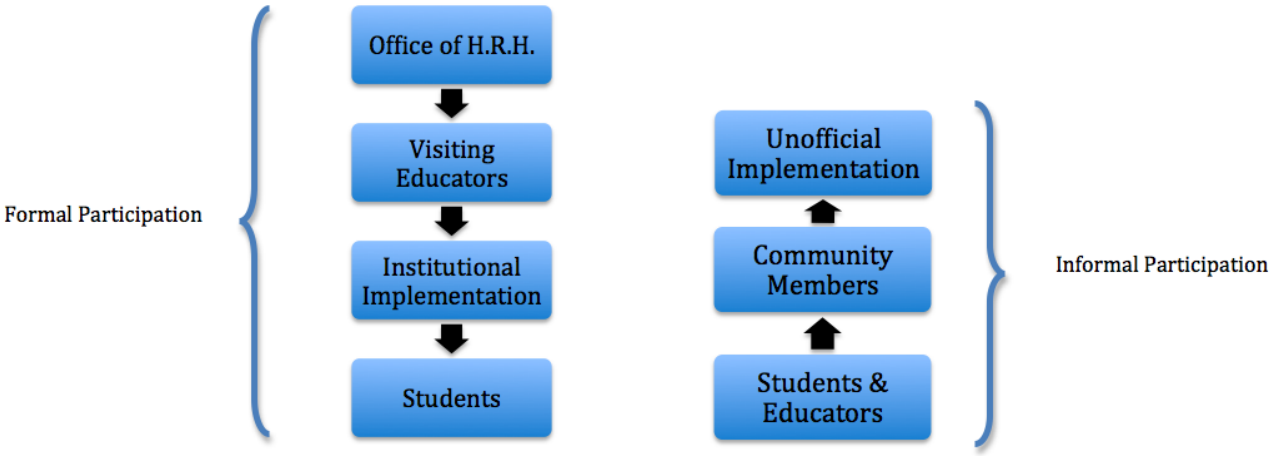

Figure 2: The potential channels of top-down and bottom-up dissemination that could occur at an educational demonstration site like the one in Na Yao.

Figure 2 above shows two possible channels of information dissemination present at a demonstration site like the one in Na Yao. The left side of the figure shows top-down dissemination through formal participation in a program where educators visit a demonstration site and hopefully gain the correct knowledge and attitude to transfer a beneficial practice to their home institution. Ideally, the practice then becomes a part of the students' education. The right side of the figure shows bottom-up communication in which students and educators with knowledge of an idea or practice spread it to community members such as friends or relatives, who may then be influenced to adopt it. While this project focuses on the design of media for use in a primarily top-down channel, understanding the progress of bottom-up communication at the Na Yao demonstration site can potentially identify success stories of sustainable development, which can enhance the media's efficacy at influencing positive attitudes in the target audience.

2.3.2 Participatory Action Research as an Approach to Designing Effective Media

Elements of an approach known as "Participatory Action Research," (PAR), can increase the effectiveness of informational media through the synthesis of stakeholder opinions. In *Participatory Action Research Approaches and Methods: Connecting People, Participation, and Place*, Kindon, Pain, and Kesbey (2007) define PAR as "researchers and participants working together to examine a problematic situation or action to change it for the better" (p. 1). All stakeholders are thus included in problem identification, and have the opportunity to offer solutions to problems like spreading self-reliance. In designing media, incorporating an approach that involves all stakeholders can lead to greater effectiveness, especially if the target audience shares characteristics with the research participants.

However, caution should be exercised when using PAR because of cultural dynamics. Due to the involvement of multiple groups, research by Kindon et. al. (2007) states that PAR can be complicated by power structures within a community or organization. If used carefully, PAR can work to design media with the assistance of the community members and guide the development of successful informational media. According to Bessette (2007) in his United Nations paper *Facilitating Dialogue, Learning and Participation in Natural Resource Management*, combining traditional and non-traditional research methods can help design media that better connects to the target audience, thus making it more effective. There are several different styles of media that can work together to effectively convey information that can be discovered using PAR.

2.3.3 Advantages of Using Multiple Forms of Media

Different types of media have strengths and weaknesses based on how they deliver information to the viewer. According to Kozma (1991) in his paper *Learning with Media*, factors that affect the efficacy of media include whether they deliver information by a visual means, verbal means, written means, or some combination of these modes. These factors influence the viewer's cognitive engagement and thus their comprehension of information. Additionally, some media may require more technology than others, which affects matters of access and distribution. Using multiple forms of media to convey a topic can compensate for the majority of these differences. Frost and Marx (1998) assert that a properly composed multi-media approach combines the strengths of each different type of media and minimizes the weaknesses. The Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Office requested both videos

and brochures to promote sustainable development and self-reliance across Asia. According to Frost and Marx (1998), print media can provide basic to moderate levels of comprehension, while videos can provide cognitive engagement. Brochure analysts Di Blas, Paolini and Rubegni (2010) argue that these two mediums, brochures and videos, complement each other when used in multi-media by reinforcing written information with verbal instruction and imagery. Educators can learn the basics of the wood vinegar, biofertilizers and biogas projects by reading brochures. They can then watch videos to learn how to accurately perform each step of the projects and be inspired to start their own sustainable practices.

2.3.3.1 Brochures

Brochures effectively provide concise and up to date information about the programs and services an organization offers. According to Di Blas, et. al (2010), they are used to convey several key ideas to an audience in order to generate interest and provoke viewer inquiry into the topic. The dissemination of brochures is aided by their low individual cost and limited technology requirement. These factors make them particularly effective in raising awareness in underdeveloped areas. This is demonstrated in a case study by Bessette (2007), in which researchers used PAR in Uganda to facilitate the creation and use of informational brochures by banana farmers struggling with poor soil quality. Furthermore, ease of customization enables brochures to be tailored to a specific audience. Research by media developers Skinner, Campbell, Rimer, Curry, and Prochaska (1999) shows that this tailoring process improves information retention.

However, brochures are not ideal for direct instruction because they only allow a relatively small amount of information to be conveyed. Brochure critic Albarracin (2003) found that brochures are the least effective form of media for information retention, as they are often too short to convey sufficient information on a given subject. Therefore, they are best used to introduce topics rather than teach them, especially in a multi-media presentation. Coupling brochures and videos is particularly effective, as Albarracin (2007) discovered. In this combination, brochures serve to arouse interest, while videos maintain audience attention and provide information. In the context of this project, brochures can be used to provide more basic information for a particular practice and be supplemented by videos.

2.3.3.2 Videos

Video media excel at providing the maximum amount of information in the minimum amount of time while still maintaining the viewers' interest. The unique combination of visual and auditory stimulation appeals to a variety of learning styles and increases the rate at which information is absorbed. Baggett and Ehrenfeucht (1981) determined that this enables more information to be conveyed in a shorter amount of time. Video analysts Kaufman and Mohan (2009) agree that viewers tend to be far more receptive to visual media than the traditional text-based approach. Additionally, videos can be shown without the presence of an instructor, which saves valuable resources. This is important to the problem at hand because instructors at the Na Yao schools currently take time out of their work day to give visiting educators a tour of the demonstration site and explain the wood vinegar, biofertilizers, and biogas projects.

For video media to be optimally effective, viewers must have some pre-existing concept of the topic presented. Researchers Huston and Wright (1983) argue that the audience should have a moderate comprehension of a subject prior to viewing because this maximizes both attention levels and viewer comprehension. Hannafin and Hughes (1986) discovered that one methods of achieving this is to orient the viewer with a series of key points on a subject. Brochures, with their frequent use of bullet points and numbered lists, are perfect for this task. Furthermore, brochures can be effective in undeveloped areas, which often lack the technologies that Balit (2007) claims are needed for videos to be effective on a larger scale. Thus, while videos may be effective at a demonstration site, they could be more difficult for visitors to use as a dissemination tool after they visit.

2.4 Conclusion

This literature review provides insight on the important social impacts of sustainable development, its broad support within governments and other organizations, and its specific role at the Na Yao demonstration site sponsored by the Office of H.R.H. Princess Maha Chakri Sirindhorn's Projects. The synthesis of this information establishes the potential impacts of disseminating the useful knowledge of specific sustainable development initiatives located at this demonstration site to educators visiting from other remote rural areas. These impacts include the spread of self-reliance, the improvement of natural resource management, and continued education for sustainable development. A discussion of communication frameworks and their potential roles at a demonstration site leads to the conclusion that significant empirical research

at the Na Yao demonstration site can bring about effective information dissemination by informing the design of informational brochures and educational videos.

In the following chapter, the team employs a variety of methods to determine the message of the media and clarify the communication goals of the project. The report describes the design, implementation, and analysis of an interview with the Office of H.R.H.'s Projects, PAR at the Na Yao schools, an interview with a successful farmer employing sustainable practices, and a student questionnaire.

3. Determine the Message of the Informational Brochures and Educational Videos

The combination of several research methods allowed the project team to determine the desired message of the informational media and meet the sponsor's goal of developing brochures and videos that inform educators about sustainable development and self-reliance in Asia. The team conducted interviews and surveys to learn about the problems that the Na Yao schools face, establish the current practices at this site, and clarify the goals and desired message of the media. Collecting opinion-based information from representatives of the Office of H.R.H.'s Projects and the teachers at the Na Yao schools allowed the team to understand the media's communication goals. This decision is supported by Balit's research (2007) on the importance of understanding the preferences of all stakeholders in a given issue. The goal of this project, as stated by representatives from the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects, is to promote sustainable development and self-reliance to educators who visit the Na Yao schools and similar demonstration sites throughout Thailand. This will allow them to bring these practices back to their own institutions and spread sustainable development throughout Asia.

This chapter describes the methods the team used to determine the media message and the analysis of data resulting from these methods. The chapter concludes with an explanation of the media message, which the team has organized in themes.

3.1 Methods to Determine the Purpose and Procedures for the Brochures and Educational Videos

This section describes the methods used to determine the purpose of the media and the procedures of the wood vinegar, biofertilizers, and biogas projects. These two concepts are important components of the overall message to be conveyed by the informational brochures and educational videos. By learning from the Office of H.R.H. Princess Maha Chakri Sirindhorn's Projects and the teachers and students of the Na Yao Schools, the project team was able to clarify communication goals and better understand the wood vinegar, biofertilizers, and biogas projects.

3.1.1 Interview with Representatives from the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects

The Office of H.R.H. Princess Maha Chakri Sirindhorn's Projects plays an important role as a primary stakeholder in this project. Systems engineer Moisiadis (2002) cites the importance of accessing stakeholder opinions, particularly as they relate to a design process. According to Moisiadis, "the various levels at which each stakeholder perceives and reasons about the system can provide valuable input into why various functionalities may or may not be important" (p. 2). This advice can be applied to the team's consideration of both the important functionalities of the media and the important procedural components of each project. Because of the value of stakeholder opinions, the project team decided to hold a semi-structured interview with representatives from the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects. The semi-structured interview allowed for the creation of a set of questions that was delivered to the Office of H.R.H. two days prior to the interview. According to social scientists Miller and Salkind (2002), the open-ended nature of questions and opportunity for face-to-face communication in a semi-structured interview allows for flexibility in asking the subjects follow-up or clarification questions. The project team benefitted from these opportunities throughout the course of the interview.

The format of this interview was a formal meeting with all four of the Worcester Polytechnic Institute students and the three students from Chulalongkorn University present. Three representatives from the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects responded to the project team's questions. In order to minimize translation errors, the interview was conducted in English and any confusing questions or responses were clarified in Thai. In cases where Thai language was used during the interview, the Thai students provided immediate translation to their American counterparts. A transcription of this interview can be found in Appendix C of this report.

3.1.2 Participatory Action Research at the Na Yao Demonstration Site

The project team supplemented the information collected in the interview by using Participatory Action Research (PAR) with the educators and students at the Na Yao schools because the success of informational media can often depend on the involvement of community members. Additionally, PAR expert Huesca (2003) recommends strong researcher participation in development efforts, which the team achieved through this method. The team was able to

participate in the wood vinegar, biofertilizers and biogas projects and fully understand the components of each in order to easily incorporate them in the informational media. This method was selected because education theorists Haury and Rillero (1994) state that performing a task increases the understanding and retention of critical steps. Participation offered the team an inside perspective on the scope of sustainable living and self-reliance. The team also began to develop relationships with other project participants such as educators, whose honest input proved valuable to future research steps, such as the team's media assessment that is described in Section 5.4 of this report. These results aided in designing media that creates shared character between those who send the message and those who receive it.

As another crucial component of PAR, educators and students demonstrated their feelings towards the different projects and felt more involved in the education of those who visited the village. They had the opportunity to teach the project team about the projects and portray the projects as their own. They described the important aspects and benefits of each project to the team. During this phase, all seven members of the project team and two members from the Office of H.R.H.'s Projects went to the Phrarachathan Na Yao Secondary School and the Na Isan Border Patrol Police School to observe and participate in the projects for four days.

3.2 Methods for Studying the Dissemination of Knowledge in Na Yao

Understanding the dissemination of knowledge on beneficial sustainable practices within the community surrounding a demonstration site can inform informational media design by identifying instances of successful development. Incorporating these methods into media design can better convince visiting educators of the benefits that sustainable development can offer a community.

3.2.1 Student Dissemination Questionnaire at the Na Yao Schools

The project team used a survey questionnaire to study the dissemination of knowledge in Na Yao because this method could provide them with an overview of the students' opinions as well as the details of one specific example of dissemination. The questionnaire can be found in Appendix D. It asked the students at the Na Yao schools about the dissemination of information on sustainable lifestyles throughout the village. A questionnaire was chosen because according social methods expert Bailey (1994), questionnaires provide a quick way to reach a relatively large audience. Given the short time available for field research in Na Yao, this characteristic

allowed the team to identify individuals who have disseminated information on the projects to others.

The eldest, most knowledgeable and most experienced students at the Na Isan Border Patrol Police School and the Phrarachathan Na Yao Secondary School were surveyed so that the project team could learn about the dissemination of knowledge related to sustainable development projects at both schools. These students experience the benefits of some of the projects and learn about them in a formal setting, so they are well qualified to participate in this survey. Fifteen of the sixth graders at the Na Isan Border Patrol Police School and forty-three of the twelfth graders at the Phrarachathan Na Yao Secondary School responded to the questionnaire, which was delivered in Thai. Each student had an unlimited amount of time to complete the survey, but the majority of the students were able to complete it in less than twenty minutes.

The project team discovered that many students did not understand the terminology of the questionnaire, particularly with the use of the words "sustainable development projects." In order to compensate for this interpretation error, the project team provided clarification by explaining to all of the students that the "sustainable development projects" are the wood vinegar, biofertilizers and biogas projects. The team made sure that they did not explain the term in a way that may skew the results of the questionnaire. Each of these clarifications can be found in Appendix D. As a result of these questionnaires and clarifications, the team was able to speak to the visibility of projects within the community and highlight the success of the projects as experienced by the students.

3.2.2 Interview with Sustainable Farm-Owner to Study Dissemination

The second method for studying the dissemination of knowledge was to conduct a semi-structured interview with a young man and his father who the project team met during their one day introductory trip to Na Yao. The young man attended the Na Isarn Border Patrol School, graduated from the Phrarachathan Na Yao Secondary School and brought sustainable practices to his father's farm. He won the King's Scholarship for his devotion to education and attended a university in Japan because of his dedication.

In the semi-structured interview, the project team learned that this family believes that the spread of sustainable practices in remote areas of Thailand is rare and requires patience, but can also be extremely beneficial. The project team discovered more about this specific example of

the spread of sustainable practices to a local farm. The team created interview questions prior to arrival at the farm and used these questions along with ones that were developed throughout the interview in order to learn about the new topics that were introduced. The interview with the father and his son took approximately an hour and a half. In the interview with the student's father, the project team inquired about which aspects of the projects that his son worked on were most appealing, and what ultimately convinced him to use these self-reliant practices. The team acquired information on why these individuals decided to spread sustainable practices to their farm and what information they learned from each other. This interview informed the team by aiding in the selection of benefits to highlight in the media. Appendix E describes the information that the project team obtained during these interviews.

3.3 Understanding the Dissemination of Knowledge on Sustainable Development in Na Yao

In order to understand the current state of dissemination on the sustainable practices that are taking place at the Na Yao schools and determine the overall message of these projects, the students must be interested in sharing their education. When the project team performed a dissemination questionnaire with the students at the Na Yao schools, the team learned that the majority of them were inspired by the sustainable development projects and forty two out of fifty eight of them have shared what they have learned with others. According to the students, they have shared information with family members, visitors who come to the schools, government officials and other villagers in Na Yao. While this data shows that the sustainable development projects have a certain degree of visibility within the community, the team did not have adequate field research time to perform a more detailed inquiry and learn how sustainable development has been disseminated from the Na Yao schools to the families and farmers in the area. The team had planned to perform follow-up interviews with students and their families to further understand how projects might be spread in the community. Although this opportunity did not arise, the fortuitous interview with the local farmer allowed the team to incorporate the success of a community member in the media designs.

The project team learned that all fifty eight of the surveyed students believe that they benefit from the schools' projects. The various benefits are shown in **Error! Reference source not found.** below based on the number of students that made similar comments.

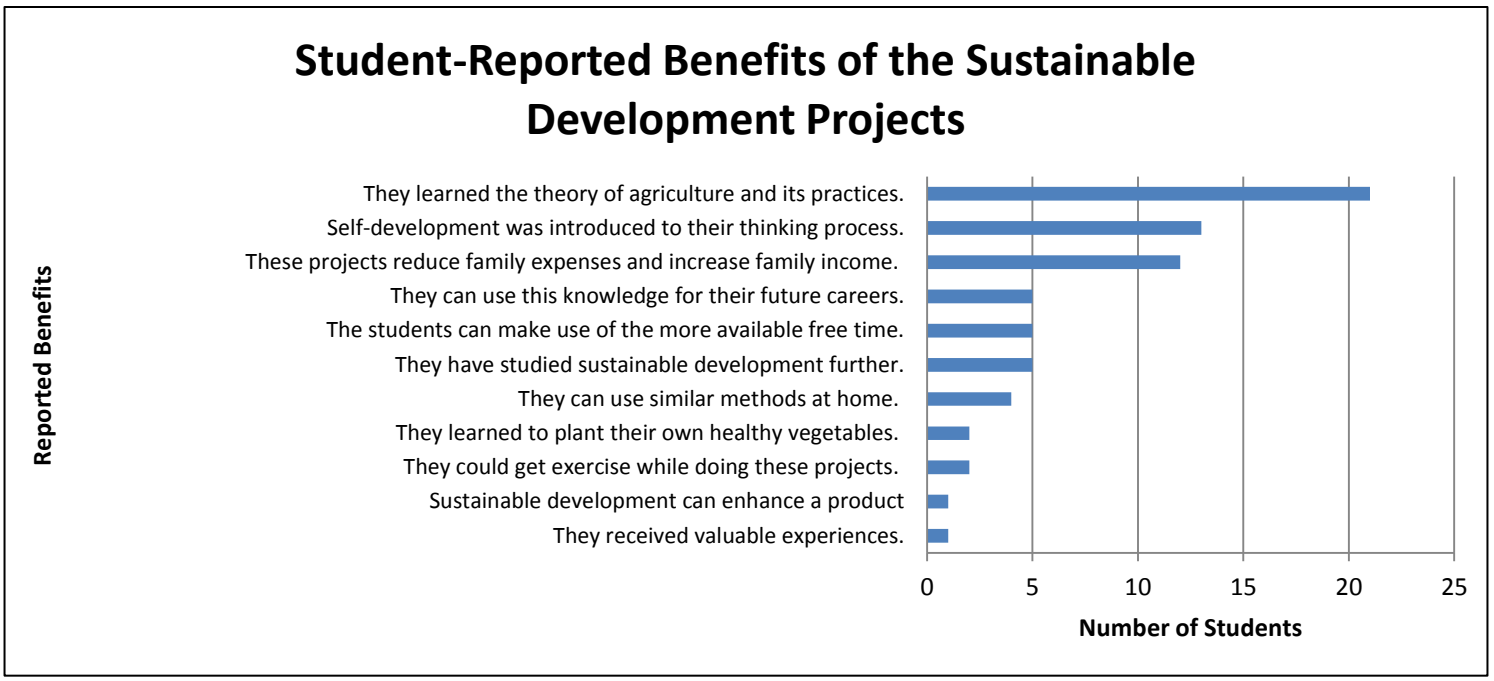

Figure 3: A graph showing the benefits of the sustainable development projects that were reported by the students in Na Yao in the student questionnaire.

Thirteen of the surveyed students learned to incorporate self-reliance in both their thinking process and in their studies. Twelve of the fifty eight students believe that these projects can reduce family expenses and therefore increase their family incomes, which could also indicate that some community members have implemented these projects outside of the schools. Most of all, students expressed that their practical education teaches them about the theory of agriculture and its practices. The students' encouraging opinions on the outcomes of the sustainable development projects helped the project team identify project benefits to include in the message of their informational media. Forty three out of the fifty eight students responded that they had seen someone using a form of sustainable development outside of school. The inclusion of these benefits will hopefully aid in motivating educators into action by inspiring positive attitudes about sustainable development projects.

The project team discovered that one notable community-based success of the Na Yao demonstration site is the story the local farmer and his son. This local farmer was able to bring his family out of debt and start to become independent of the need to purchase food and health products. He appreciates his opportunity to learn about the projects through his son, who attended the Na Isan Border Patrol Police School as a young boy, and through his attendance at

seminars on the King's Sufficiency Plan. Through exposure to the projects at his son's primary and secondary schools, and the realization of his unsustainable lifestyle, which included significant income spent on gambling and alcohol, this local farmer was inspired to learn more about the concept of self-sufficiency. He spoke to the initial difficulties of moving away from a traditional, profit-based farming model, but eventually he was able to achieve self-reliance and even adapted the school's biofertilizers technique for his own farming. Despite the many benefits that this farmer has experienced as a result of these innovative practices, he predicts that only a small percent of the local villagers would actually consider implementing such practices. He expressed that it is difficult to inspire people to change their behavior, which is a significant challenge to overcome. As a result of this input, the team reinforced their understanding of the importance of positively influencing the attitude of the target audience. This increased appreciation for the challenges of disseminating sustainable development spoke to the significance of carefully identifying and characterizing the media message.

3.4 Identification of Themes: Synthesizing Data to Determine the Overarching Media Message

This section discusses how insight obtained in Sections 3.1 through 3.3 feed into the overall message of the informational brochures and educational videos. The project team identified four major themes that work together to form an appropriate media message. They are organized into themes, which led to the team's success of incorporating into the media during the generation phase. The team made sure that any content in their media falls under one or more of the following themes.

3.4.1 Transferring Self-Reliance

Self- Reliance emerged as the primary take-away message of the desired media. During the semi-structured interview with the sponsor, when asked what aspects of the projects are most appealing to the mission of the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects, the concept of self-reliance was the first response. In expanding on this point, interviewee Dr. Nantaporn Viravathana expressed that a focus on project procedure is necessary to allow for the successful transfer of sustainable development projects that emphasize self-reliance. Other comments supporting this theme can be found in Table 1 below.

	Interview Evidence Supporting a Procedural Purpose for the Transfer of Self – Reliance
1	"Project procedures have been the most difficult project aspects to communicate to visitors in the past"
2	"There is a lack of a standardized or 'international' project procedures"
3	"Procedures should be conveyed in a way that steps can be adapted to another setting"
4	"The context of the projects should not be the main focus, as the purpose of the media is to allow for implementation elsewhere"
5	"Educators from countries with similar natural environments to the Na Yao region are chosen as visitors by both UNESCO and the governments of their home country"
6	By focusing on the procedure of each project, they hope to minimize the need for "additional action" from the Office of H.R.H. after an educator visits
7	A school in Laos implemented the biofertilizers project and quickly found themselves confused on some of the steps, necessitating clarification from The Office of H.R.H.

Table 1: Quotes from the project team's interview with the Office of H.R.H. that support demonstrating the procedure of a project to transfer self-reliance.

According to the interview subjects, normally, only a brief demonstration of a project is given to the educators who visit the village, which leaves gaps in information for these educators. However, the concept of self-reliance can be transferred to other remote areas if project procedures are communicated according to the sponsor's goal. Additionally, a focus on disseminating this theme provides visiting educators with enough detailed information to carry out their own sustainable development project at their home institutions.

3.4.2 Conveying Educational Benefits for Students Participating in Sustainable Development Projects

The educational benefits that students receive, especially in simple math and science, make up a secondary message to be included in the designed media. Since the target audience consists of educators, conveying these benefits can create shared character between the media sender and receiver. Additionally, in the interview with the Office of H.R.H., representatives explained that the home institutions of visiting educators typically "have less funding and a weaker curriculum than the schools in Na Yao." When asked if visiting educators are usually interested in sustainable development projects prior to their visit to the Na Yao schools, representatives from the Office of H.R.H. stated that "visitors are interested, especially if they are looking to implement an interactive curriculum." In a student questionnaire thirteen out of forty three twelfth grade students at the Phrarachathan Na Yao Secondary School indicated that the projects provide self-development in their thinking process and learning. Twenty six out of forty three twelfth grade students cited learning about the theory and practice of agriculture as a benefit of the school's curriculum. All of this data indicates that educational benefits can emerge from sustainable development.

To convey the integration of the projects under the larger goal of sustainable development, the team decided that a separate brochure providing an overview of the schools' hands-on curriculum would be beneficial. This brochure sets up a context and primes the message receiver for more detailed information on wood vinegar, biofertilizers, and biogas. Using a separate brochure is in keeping with the Office's request that the context not be a focus of the main informational media. Additionally, some basic scientific information can be incorporated into the informational media on wood vinegar, biofertilizers, and biogas. This will allow educators to share fundamental scientific aspects of each project with their students, which emphasizes the Princess's goal of stressing the importance of scientific topics in daily life.

3.4.3 Demonstrating Quality-of-Life Benefits

Based on the research of Dozier and Ehling (1992), demonstrating quality-of-life benefits for students in the designed media helps to create positive attitudes in the message receiver. For example, the students in Na Yao now receive food while at school instead of going home to find food. The agriculture programs in Na Yao help provide the students with lunch every day. When asked how the standard of living has improved in Na Yao, representatives from the Office of

H.R.H. stated that this is one of the benefits of the projects taking place in the schools. The team observed school lunches being provided to students at both the Na Isan Border Patrol Police School and Phrarachathan Na Yao Secondary School. In a student questionnaire, nine out of fifteen sixth graders and twelve out of forty three twelfth graders indicated that projects help to reduce family expenses because of their grounding in the principles of self-reliance. Additionally, the local farmer who practices sustainable development cited several specific quality-of-life benefits, such as the ability to make efficient use of resources found within the immediate natural environment for food, shelter, and health products. Including such benefits in the message of the brochures and videos can demonstrate the positive results of using sustainable agriculture.

3.4.4 Promoting Environmental Awareness

Environmental awareness is the final theme to be included in informational media. By appealing to the audience's sensibilities surrounding the preservation their immediate environment, the media can help educators grasp the gravity of moving towards sustainable living. Through observation and inquiry at the Na Yao schools, the team also learned that this is a goal of the schools' innovative curricula. For example, environmental awareness is taught through discussion of the differences between chemical fertilizers and biofertilizers or between chemical pesticides and wood vinegar. The team discovered that biogas is taught as a clean energy source, and reduces the secondary school's reliance on LPG fuel by twenty five percent each month. In the interview with the Office of H.R.H., representatives expressed a belief that the concept of environmental awareness could be transferred to other schools in remote areas; "visiting educators can incorporate principles of environmental awareness into a future lesson plan." If educators have an idea of how these projects are sustainable alternatives for environmentally damaging practices, they can pass this message on to their students.

4. Methods for Developing an Effective Series of Informational Media to Disseminate Sustainable Development

In order to develop media, designers must develop a series of guidelines to follow so that each component of the media receives attention. This section explains how the project team developed their informational media on the wood vinegar, biofertilizers and biogas projects and the reasoning behind each of the choices made. The team used a method of designing media adapted from prominent literature in order to ensure that the final product was thorough and easy for educators to understand. First, the project team describes the original method for developing media that was discovered during archival research. The project team then describes the slight adaptations they made to this model so that it could better suit this project.

Before undertaking a detailed study of the media development process, media designers must understand some general characteristics of successful media. Brochures and videos, especially when used for marketing or educational purposes, have several crucial characteristics that can render them extremely successful if correctly acquired. According to media developer Boame (2010), these specific characteristics include quality, contrast, transparency, innovation, and organization. Each of these characteristics is described in detail in Table 2 below.

Characteristic	Description
Quality	Depends on the budget, but typically a larger budget allows for more attractive media
Contrast	Must be easy to distinguish from other media and have a unique layout
Transparency	Depends on the product's ability to spread concepts and allow for the audience to absorb the desired ideas and practices
Innovation	Aroma of a media design and can convince people to take action
Organization	Must be well-planned, well thought out and prepared in a clear step-by-step process

Table 2: A table adapted from Boame (2010) describing the important characteristics that must be considered when designing informational brochures and educational videos.

The project team identified these characteristics prior to developing their media to ensure that their final series of informational brochures and educational videos were of high quality and well organized. The team used innovative design to spread the concept of sustainable development and allow for the educators who will be reading the media to absorb this innovative idea. As a result, the team made eight brochures and six videos that are easy to distinguish from other media on wood vinegar, biofertilizers and biogas. They used the principles described in the next section as a guideline for the development of their media.

4.1 The Guiding Principles of Instructional System Design

Instructional System Design (ISD) is an effective method for designing and evaluating informational media. It provides media designers with a series of phases to complete while making their products. Media analyst Clark (2010) uses a model called Analyze, Design, Develop, Implement, Evaluate, or ADDIE, to evaluate a medium and determine its ability to be successful. According to Clark (2010), educational training videos that were modeled after the ADDIE system were used to improve safety in the workplace at the Wholesome Path Food Company. These videos effectively prevented the Occupational Safety and Health Administration (OSHA) from shutting down the company. This study shows how the proper use of media can have a positive impact on an audience.

The ideas and practices of sustainable development can be disseminated through the use of brochures and videos based on the ADDIE plan. By adapting the ADDIE plan and incorporating the various characteristics of informational media into the design of a brochure or video, the final product will be more likely to have the desired effects on the target audience. The two effective media, brochures and videos, can be used to supplement each other and expand educators' knowledge on wood vinegar, biofertilizers and biogas.

4.2 Setting the Stage for Media Development: The Methods to Analyze, Plan, Generate, Assess, and Revise

In order to develop an effective series of informational brochures, the team followed an adapted version of the ADDIE plan that is more suitable for the needs of their media. Due to time restrictions, the implementation phase of the ADDIE model could not be completed. The team performed an assessment, but it could not be carried out over a long period of time as suggested by the ADDIE plan. Therefore, the group's adapted model was called Analyze, Plan,

Generate, Assess, and Revise (APGAR). The details of this method can be seen in Figure 4 below and are described in more detail following the figure.

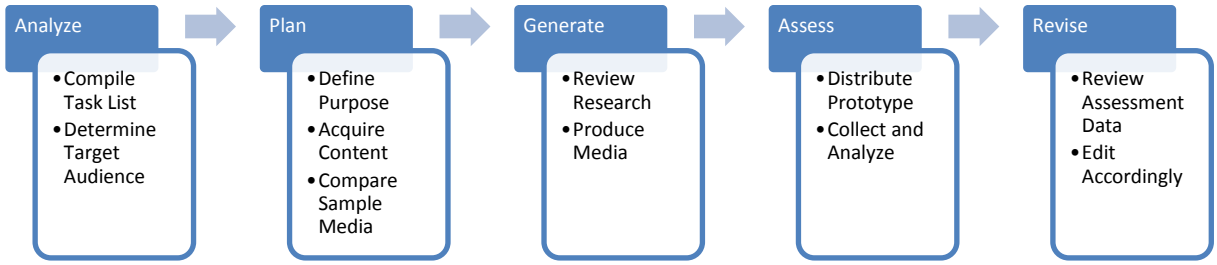

Figure 4: The Analyze, Plan, Generate, Assess, Revise (APGAR) method that was used by the project team to properly design informational brochures.

As demonstrated in Figure 4, the first step of this plan includes the analysis phase because the mission of a medium needs to be identified prior to proceeding its development. During this phase, the team determined the primary requirements for their brochures and videos. The team decided what tasks they needed to accomplish in order to achieve their goal. A major component of this task list included identifying the target audience and determining how to best portray the information on the benefits and procedures of each of the projects. By doing so, the project team ensured that the brochures and videos that they developed will appeal to the educators who use them.

Moving into the second phase of Figure 4, the planning phase of this project is critical because it allows the developer to determine the purpose of the media. According to Professional Advertising (2005), the purpose of the media must be identified before starting the design phase. Brochures are often designed to either attract a new client's attention or to follow through with clients who are interested in more detailed information (Professional Advertising, 2005). On the other hand, videos are designed to provide more detail than brochures since they have more availability for in-depth descriptions. According to the requests of the Office of Her Royal Highness, these forms of media will be used to attract the attention of a new client, or in this case, inspire an educator who visits the Na Yao schools. Brochures and videos are two effective ways of capturing an audience's attention and then providing them with the information they need to improve their lifestyle; therefore, the project team went forward with the design of these two types of media.

As demonstrated by the second bullet under the planning phase in Figure 4, the next crucial step is to establish the content of the media. According to media expert Bear (1997), background information on a topic, such as sustainable development, must be identified in order to continue on to the design phase. Completing this step allowed the project team to gain an understanding of the media topics. The majority of the content for the media was collected during the methods described in Chapter 3. In their first meeting with the project team, the Office of H.R.H. requested that the information on the procedure and benefits of wood vinegar, biofertilizers and biogas be included as the main focus of the informational media.

The third bullet of the planning phase in Figure 4 is to review sample brochures in order to design media that are innovative yet possess similar qualities as existing media. Media analyst Bear (1997) suggests that media developers identify a common style and format to imitate when generating their product. The project team performed a descriptive and a prescriptive genre analysis in order to discover the commonalities between brochure styles. In this genre analysis, the project team identified similarities between informational brochures and educational videos that are used to promote sustainable development and environmental awareness. In her report titled *Genre Analysis and Comparison,* Driscoll (2005) claims that a genre analysis can be performed based on four categories: rhetorical purpose and audience, content, structure and linguistic features. Based on Driscoll's category definitions (2005), the project team decided to perform a content genre analysis and a structure genre analysis. Through these two methods, the team learned what kind of data is typically provided in informational media, how it is structured and how all of the components connect to each other. Following the genre analysis, Bear (1997) suggests that this research be synthesized into criteria that will guide the design of the media.

As identified in Figure 4, the third phase of the APGAR method involves generating the informational media by conveying the information that the team learned in an appealing manner. The generation phase can be smoothly executed by following the criteria created during the plan phase. In order to meet the requests of the Office of H.R.H., each brochure and video has been developed in both English and in Thai. This allows for the media to cross both cultural and language barriers that can be present between the variety of educators who visit the schools in Na Yao.

Once a prototype of the media is created, the team can move on to the fourth component of the APGAR method in Figure 4 and assess the designs to discover the strengths and

weaknesses of the samples. This decision is supported by Bear (1997), which suggests that a quality check be performed in order to develop the most effective series of final products as possible. The project team used questionnaires to assess their media based on the suggestions of social researchers Hopfner and Rey (2009). According to Hopfner and Rey (2009) questionnaires typically include true or false questions or Likert scale questions. In his article, *Likert Scaling Research Methods,* Trochim (2006) defined a Likert scale question as a type of multiple choice type question that asks the subject to identify the level of agreement or disagreement they associate with a statement.

In order to prevent the subjects from providing the answers that they believe the project team is interested in seeing, a description of the purpose of the questionnaire and the importance of honest answers is included at the beginning of the survey. According to social researcher Bailey (1994), "the best inducement for an honest reply is simply to convince the respondent that the study is worthwhile and that his or her cooperation is important. Another strategy is to appeal to his or her 'good Samaritan' instincts, telling him or her that you need his or her help" (p. 139). This approach is included in the questionnaire description in order to bring forward truthful responses.

Unfortunately, educators only visit the Na Yao schools a few times each year, so the media could not be assessed by members of the target audience. In order to compensate for this problem, the project team performed a brochure assessment with the educators and students at the Na Yao schools but did not have enough time to do the same with the videos. The project team provided a supplementary assessment with their advisors and representatives from the Office of H.R.H. in order to receive feedback on their designs.

The final phase in Figure 4 is the revision phase, which allowed the project team to create a more thorough form of media that appeals to the target audience. Media analyst Bear (1997) asserts that media prototypes should be revised based on the information collected in the assessment questionnaires. The team analyzed the results of their assessments and identified gaps between what the subjects learned from the media and what information the team hoped to convey. The completion of this phase resulted in eight brochures and six videos that are included as an additional component of this report and were presented to the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects.

Each of these five phases of media design was used to develop the project team's effective series of informational brochures and educational videos. Their adapted version of the ADDIE method proved to be crucial to the development of their media. The following chapters describe how the team analyzed, planned, generated, assessed and revised their product to develop eight brochures and six videos that will promote sustainable development to educators who visit the Na Yao schools and similar demonstration sites throughout Thailand.

5. The Development of Informational Brochures

Informational brochures need to be carefully designed and well-planned in order for them to be effective forms of disseminating knowledge on a product, idea or concept, such as sustainable development. According to media developer Marker (2005), brochures are useful for "illustrating the company's design philosophy, attitude and most importantly, their product ranges" (p. 28). Therefore, the team generated eight different brochures in both Thai and in English on wood vinegar, biofertilizers and biogas as well as an overview brochure on the innovative and integrated curriculum at demonstration sites throughout Thailand. These informational brochures include details on the benefits, procedures and background of the projects, while the overview brochure describes how these projects have affected the students and the schools based on what the team learned in Na Yao.

The development of brochures on the overall successes of the demonstration sites and three of the sustainable development projects can be of great use to the educators who visit the schools. The educators can easily bring these brochures with them back to their own schools and use them to implement their own sustainable development projects. They help disseminate knowledge from Thai demonstration sites to other remote areas of Asia and help transform ideas into actions. This chapter proves why brochures are useful and how the project team followed their Analyze, Plan, Generate, Assess, Revise (APGAR) method described in Section 4.2 to develop an effective series of informational brochures. Each of the following sections describes the implementation of each phase of the APGAR method and analyzes the results of that phase.

5.1 The Analysis Phase for Designing Informational Brochures

In the analysis phase, the team determined that their target audience is educators who visit the Na Yao schools and devised a list of important tasks to follow. The first task that the team identified was to determine how to convey the desired message to the target audience. This ensured that the brochures appeal to the educators who read them. The second step on this task list included determining the information that needed to be included in the brochures. This allowed the project team to determine the content of the media. The final task was to take pictures and select the best ones to be used in the media. This helped the team determine the visual appeal of the brochures. Each of these tasks allowed for the project team to identify what

they needed to do before they started working. This phase was completed within the project team's first few weeks in Thailand.

5.2 The Planning Phase for Designing Informational Brochures

A plan needs to be developed prior to designing an effective series of informational media. During their interview with representatives from the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects, the team completed the first step of their plan and determined the purpose of their media. They learned that the media will be used to promote self-reliance and environmental awareness to educators who visit the Na Yao schools and similar demonstration sites. The goal of the Office of H.R.H. is for these educators to bring these practices back to their own countries and academic institutions (Office of H.R.H., Personal Communications, January 18, 2011).

Another component of the plan phase involves identifying the critical content of the media. In an interview with representatives from the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects, the project team learned that the brochures need to teach the audience about the benefits and procedures of the wood vinegar, biofertilizers and biogas projects (Office of H.R.H., Personal Communications, January 18, 2011). Both the representatives from the sponsor's office and the teachers at the Na Yao schools taught the project team how to perform each sustainable development project properly and showed them how the products of each project are used to benefit the schools (Office of H.R.H., Personal Communications, January 18, 2011). The results of these participatory educational sessions are displayed in each of the informational brochures that the project team produced.

The project team also conducted a prescriptive and descriptive genre analysis, during which they compared Western and Thai brochures on sustainable development and identified the important commonalities between them. As a result of this analysis, the project team was able to develop six criteria that they followed when designing the brochures. These six criteria are described in the following section.

5.2.1 The Development of Criteria for Informational Brochures

Referencing past examples of successful informational brochures and identifying commonalities that occur between them is important to developing brochures on wood vinegar, biogas and biofertilizers because it results in a product that is more appealing to the target

audience. The team studied eight Western and eight Thai brochures. They chose these sets of brochures because they captured their eye and related to similar topics as the brochures that the project team made. When analyzing the media, the project team focused on the type, layout, shape, font, color and content in Thai and Western brochures. Table 3 below shows these criteria and provides a brief description of the differences and similarities between the two different culture's preferences.

Criteria	Western Approach	Thai Approach
Type	-Prefer tri-fold brochures	-Prefer tri-fold brochures
Layout	-Stimulating cover page -Contact information on back middle page -Important information on inside flap -Include blank or white space -Often looks like the background has been designed on a computer	-Stimulating cover page -Contact information on back middle page -Important information on inside flap -Include colorful images to fill the spaces -Uses images as a background
Shapes	-Prefer rectangles and squares	-Prefer circular objects
Fonts	-Clear and easy to read	-Clear and easy to read
Colors	-Tend to use green, blue and occasionally orange	-Tend to use green, blue and occasionally orange -Uses more intense shades of colors
Content	-Focus on procedures and benefits of the projects -Information is inspiring and captivating -Information sells the product -Sentence structure varies between full sentences and bullet points	-Focus on procedures and benefits of the projects -Information is inspiring and captivating -Information sells the product -Sentence structure varies between full sentences and bullet points

Table 3: Six criteria to follow for developing Thai and Western informational brochures.

The project team identified many similarities between Thai and Western brochures, but also acknowledged several differences, which are easy to distinguish in their own brochures. For example, Table 3 demonstrates that the team discovered a significant difference in the shapes in

Thai and Western brochures. The team recognized that Thai brochures often use circles to frame an idea, while Western brochures use squares. Additionally, the project team realized that Thai brochures are extremely populated with pictures, while Western brochures incorporate white space to separate out the information. The team's final discovery is that while both Thai and Western brochures use shades of blue, green and orange, the strength of the colors in Thai brochures is much more intense than the pale colors used in Western brochures.

The creation of these criteria provided the project team with a thorough set of guidelines to follow in order to develop appealing brochures for educators who visit the Na Yao schools and other demonstration sites throughout Thailand. Based on these guidelines for creating the type, layout, shape, font, color and content in Thai and Western brochures, future teams will have advice on how they can successfully duplicate these ideas. Figure 5 below is an example of the inside of one of the Western brochures that the project team used in their genre analysis.

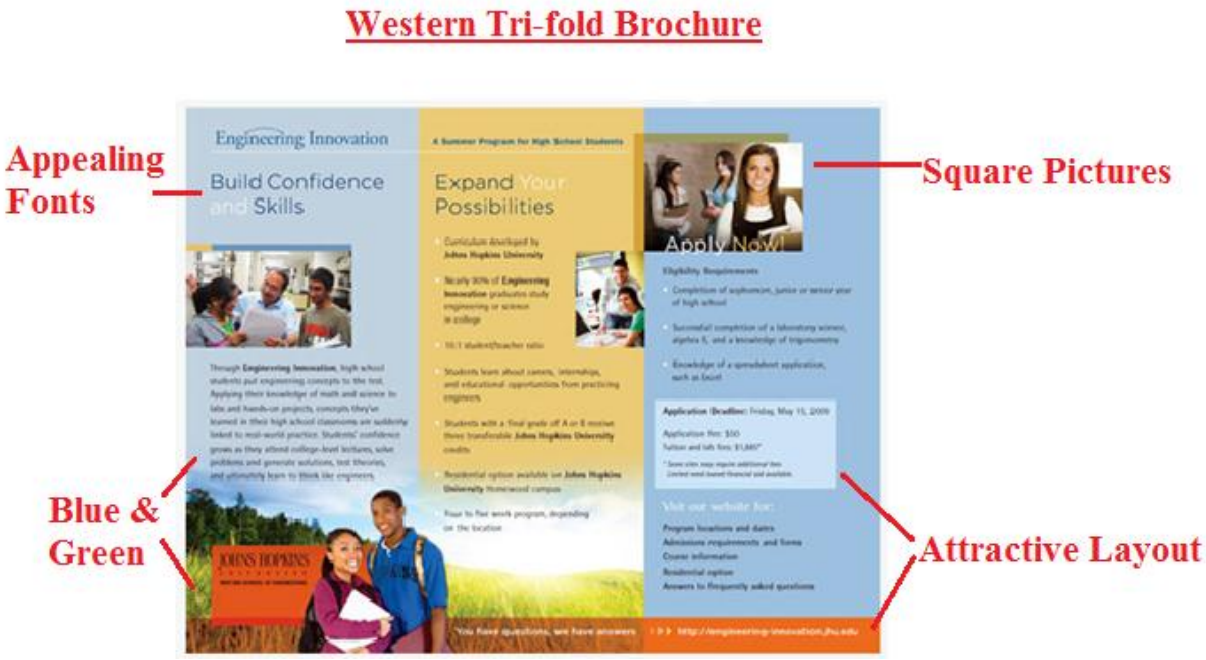

Figure 5: A Western tri-fold brochure that was used in the project team's genre analysis with several criteria identified in red text.

Each of the six criteria that the project team identified can be seen in this figure. This is a tri-fold brochure that has an attractive layout, square pictures and an appealing font. It also uses blue and green, as well as some orange, to accent the text. The brochure connects with students and teaches them about the actions that they can take to further their education.

Figure 6: A sample of one of the Thai tri-fold brochures used in the project team's genre analysis with each of the criterion identified in red text.

Figure 6 above demonstrates an example of the title flap, back cover and first interior flap of one of the effective Thai brochures used in the project team's genre analysis. It uses circles and rounded edges, the colors blue, green and orange, and appealing fonts to captivate the audience. As the project team discovered, there are many pictures throughout this brochure. This sample also has an appealing layout that sells the concepts of the brochure to the reader. These criteria are important to the design of an appealing Thai brochure.

An explanation of how the project team designed their brochures and how they accounted for the differences between Thai and Western brochures is provided below. Each of the six criteria is described separately to recognize all of the significant decisions that the project team made. The project team found it imperative to understand each of these criteria before moving on to the generation phase because they guided the development of a set of brochures that appeal specifically to the educators who will read them.

Based on the team's genre analysis, they decided to make a tri-fold brochure for each of the sustainable development projects because this style lends itself to selling a product or idea. The photographs capture the reader's attention and the folds of the flaps allow for the brochure to

immediately inspire the reader and convince them to continue reading. Different types of brochures can include between six and sixteen flaps of information, but most brochures are more concise. The majority of the brochures that the project team studied in their genre analysis were tri-fold brochures, which include six flaps of information. In their article titled *How to Build Multimedia and Multichannel Corporate Brochures*, Di Blas, Paolini, and Rubegni (2010) state that tri-fold brochures are the most common style of brochure because they are easy to use, simple to understand, innovative and can quickly be customized. The project team chose to use a tri-fold brochure, since educators will likely be the most familiar with this style and it lends itself to selling the sustainable development projects.

In order to ensure that a tri-fold brochure is conveying the appropriate information, it must follow a standard layout. The project team discovered several commonalities between the layouts of Thai and Western tri-fold brochures. First, the cover, or front flap of a tri-fold brochure has very few words on it (Professional Advertising, 2005). During the genre analysis, the team recognized that this flap typically only includes the title and company name. The images on this flap are often show happy people or the greater scope of the product or idea that this brochure is trying to promote. The genre analysis also taught the team that the first inside flap of the brochure, which is printed on the back of the paper, includes the most important information in the brochure in the form of concise bullet points. As a result, the benefits of the projects are displayed on this flap of the project team's brochures. The project benefits are the most important information to communicate to the target audience because they can capture the reader's attention and encourage them to continue learning about the project procedures and details.

The inside three flaps of a tri-fold brochure are often written in full sentences, as seen in both the Thai and the Western samples in Figure 5 and Figure 6. The genre analysis showed that these flaps include information on the history of a company or product and specific details that help promote the item. They can be divided into sections, usually with the two of the flaps including similar information and then the third flap providing details on a different component of the product. Based on this commonality between tri-fold brochures, the project team used these flaps to teach the target audience about the role of the sustainable development projects in the school and the procedures for each of the projects.

Tri-fold brochures are also one of the most visually stimulating types of brochures. In the genre analysis, the project team learned that Western brochures often use blank or white space to help distinguish between each of the flaps. This is supported by media professionals, who believe that by keeping blank and white space in a brochure, the target audience is more apt to read it (Professional Advertising, 2005). The team recognized that Western brochures include fewer pictures than Thai brochures. This is due to the fact that including too many pictures in a brochure causes the text to lose its impact and the brochure appears out of balance because it is so crowded and hard to read (Professional Advertising, 2005). In addition, the genre analysis proved that Thai brochures often have a faded picture as a part of the background, while Western brochures often have a computer generated background that has a combination of shapes in it. The back center page of both Thai and Western tri-fold brochures is often very simple and includes a faded picture on the grand scheme of the product or a solid background design. Any necessary contact information is included on this page. Therefore, the project team included contact information for the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects on this flap. Based on the team's genre analysis, these commonalities and differences in the layout of Thai and Western brochures were taken into account when designing the media to ensure that each of the six flaps of the brochures meet their role.

The layout of a brochure is complemented by the shapes incorporated in the design, which are different in Thai and Western brochures. Thai brochures use circles and ovals to accent their topics and images, while Western brochures use squares and rectangles, employing wavy designs only occasionally. As a result of these discoveries, the project team included circles and rectangles as appropriate in each of the brochure designs. This attention to the layout allows for the brochures to appeal to educators from either Thailand or neighboring countries.

Thai and Western brochures both use text that is easy to read, attractive and varies in size depending on its importance. In both types of brochures, the title of a section is written in a larger font size and in a darker shade of the text color. The tone and color of the text needs to be appropriate and not too colorful, in order to maintain suitable visibility and contrast from the background of a brochure. Table 4 below shows some details on the preferred size of the text amongst different age groups in Western and Thai characters. From this table, the project team concluded that the body of the text in their English brochures needs to be between size ten and

size twelve point font, while the Thai characters need to be between size fourteen and sixteen point font. The titles of each flap are in a larger font to allow them to be easily distinguished.

Age Group	Size of Roman Character (pt.)	Size of Thai Character (pt.)
5–7	18	24–30
7–9	12–14	18–30
10–12	11–12	16–18
Above 12	11–12	16–18
Adult	10–11–12	14–16
Over the age of 60	11–12	16–18

Table 4: A comparative table of the English and Thai font size preferences for readers of all ages adapted from Saksit and Junpen (2011).

Western and Thai brochures vary in the strength of colors that they use to demonstrate different topics. From the genre analysis, the team learned that Thai brochures usually use brighter colors that capture the reader's eye better than the standard range of faded colors that Western brochures use. As a result, the project team chose to design their brochures in blue, green and orange and made sure that the colors in the Thai brochures had a greater intensity.

In order to inspire the target audience, the content of informational brochures is typically related to the product's benefits and uses in the community. According to media design experts Bear (1997) and Professional Advertising (2005), it is good to "lead with the benefits" because inspirational or introductory information is needed to capture the reader's attention and make them want to continue reading. During their genre analysis, the team learned how to write the content of their brochures. Designers write brochures in a way that relates to the individual who reads it. The project team realized that in order to sell wood vinegar, biofertilizers and biogas, they needed to connect with the educators who will read the brochures on a personal level and sell the idea of sustainable development to the reader without using too much academic language. By establishing this connection, the information in the brochures makes the reader

feel like this idea was developed for them and that they should follow through with this change in their lifestyle. The project team established this connection in each of their eight brochures in order to captivate their audience.

The project team collected valuable content related information for these brochures through Participatory Action Research (PAR) and an interview with representatives from the Office of Her Royal Highness. PAR allows for the members of a community to connect to the media better. In order to develop this connection, the project team had the students perform the projects with assistance from their teachers so that the people in the brochures are those who actually practice the sustainable development projects. This helped the project team learn how to convey the information in a way that will connect the educators who it is designed for to the projects. Additionally, the pictures of local students performing the projects makes the idea of sustainable development seem more feasible. The material in the informational brochures focuses on the benefits and procedures of each of the three projects and is written so that educators feel as though these projects are made for them. The project team also designed an overview brochure which focuses on how sustainable living and self-reliance are incorporated into the schools' curricula and demonstrates how well these projects complement each other.

While researching the design of brochures, the team learned that the printing process is important to the quality of the brochure as well. They discovered that the reception and audiences interpretation of brochures depends on the quality of the paper, the quality of the images, and the proper formatting style. Quality analyst Duermyer (2011) claims that most brochures are made on size A4 paper since that is either 100lb or 80lb since it is typically the most cost-effective and can be printed for a minimal fee. Adding varnish can add an appealing gloss to the brochure; however, having many pictures in the brochure will create a glossy appearance anyways. Based on research from Duermyer (2011) all images in the media should be at least 300 dpi in order to print them clearly and with full sharpness. This makes the media seem more sophisticated and creates a more successful design. These effects are important for printing an appealing version of the final product. They were taken into account when the project team performed the generation phase of their brochures.

5.3 The Generation Phase for Designing Informational Brochures

The generation of informational brochures takes care, precision and proper planning. In order to generate these brochures, the project team followed each step of the analysis and plan

phases that are described above and synthesized the information that was collected. The team then placed the pictures and desired information into eight brochures that were designed in Microsoft Publisher based on the criteria that were developed in the genre analysis. Each of these brochures promotes either wood vinegar, biofertilizers, biogas or the use of sustainable development to enhance education. They disseminate knowledge on sustainable practices to the educators who will read them. As a result, communities in remote areas of Asia will have more opportunities to prosper. These communities will learn how to provide food for their families, how to improve their health, how to save money and how to efficiently use the resources that they have available to them. These brochures make sustainable development feasible for remote areas in Asia.

5.4 The Assessment Phase for Designing Informational Brochures

One of the most important factors of creating an effective brochure is assessing it with representatives of the target audience to see if the media is meeting its desired purpose and providing the appropriate content. In order to evaluate their media, the team created an assessment questionnaire, which can be found in Appendix F. All forty teachers at the Phrarachathan Na Yao Secondary School and the Na Isan Border Patrol Police School completed this assessment, along with forty twelfth grade students and fifteen sixth grade students from Na Yao. The project team chose to perform the assessment with the schools' teachers because they are the group of people in Na Yao who are most similar to the actual target audience. The students who were selected are the oldest at each of the schools and have the most knowledge on the sustainable development projects. During the assessment, each subject had an opportunity to review the sample brochures and reflect their thoughts on the visual appeal and content of the brochures as well as the content of them.

The project team discovered that there were several strengths to their media and that they had effectively conveyed the desired content. The results of the questionnaire proved that the majority of the subjects who read the brochures understood them enough to answer the content related questions. For example, when the subjects were asked to respond to the true or false question, "the production of wood vinegar is a long process that requires patience," ninety five out of ninety nine of the subjects responded correctly. This taught the team that the content of their media was effectively communicated to the subjects. The subjects also responded positively to the visual appeal of the media. Eighty three out of ninety nine of them agreed that

the brochure "grabbed their attention," and eight of them strongly agreed. Eighty four out of the ninety nine subjects also agreed that the media had "an attractive layout" and five of them strongly agreed. Another strength of the media is that sixty five out of the ninety nine subjects who responded agreed that they were "inspired to start living in a more sustainable manner," while twenty five of them strongly agreed. These results prove that the project team was able to promote self-reliance and sustainable development to the subjects through their brochures.

Despite all of this positive feedback on the brochures, the assessment questionnaire also provided the project team with some significant weaknesses to address. First of all, seventeen of the ninety nine subjects disagreed with the fact that the font was easy to read. Through comments from teachers, the team discovered many complaints about the font of the Thai brochures in particular. Through further inquiry, the project team discovered that the Thai characters were too small and decided to increase the size of them. In addition to the questionnaire, several teachers offered supplementary comments on the brochures. The teachers indicated that the Thai brochures needed clarification in wording. One of the teachers also commented that the pictures of bananas that were in the prototype of the overall brochure on sustainable development did not relate to the topic. As a result of these comments, the project team decided to incorporate new pictures in that brochure that are specifically related to sustainable development, such as the rice fields from the King's theory of agricultural sufficiency. Several other teachers commented that the brochures lacked a common theme between them. Each prototype was appealing on its own, but it was difficult to quickly identify a single brochure from the series. The project team decided to choose the Thai brochure and the Western brochure that the subjects liked the best and adjust the other brochures to use this same design. The final product includes one style of Thai brochures and one style of Western brochures, with differing colors so that they can still be easily distinguished between. The results of the questionnaire and the additional comments from the teachers were very constructive and led to a more appealing final product.

In addition to the assessment with the Na Yao educators and students, the project team was able to effectively assess these informational brochures with the sponsor and project advisors. The subjects were provided with prototypes of each of the eight brochures and gave the project team feedback on the content and design of them. In this assessment, the team learned the importance of matching colors, image alignment, and font choice. The team learned how to convey the content of the media in a more effective and inspiring manner that also filled

the page appropriately. One of the project advisors suggested that the project team used quotes as a device for relating these projects back to the educators who read the brochures. Each of these suggestions was taken into account in the revision phase.

5.5 The Revision Phase for Designing Informational Brochures

In order to finalize the brochures, the comments received in the assessment phase were translated into actions. The figures below are examples of one of the Western and one of the Thai brochures that the project team developed. This section provides insight on the revisions that the project team made as a result of their research and assessment.

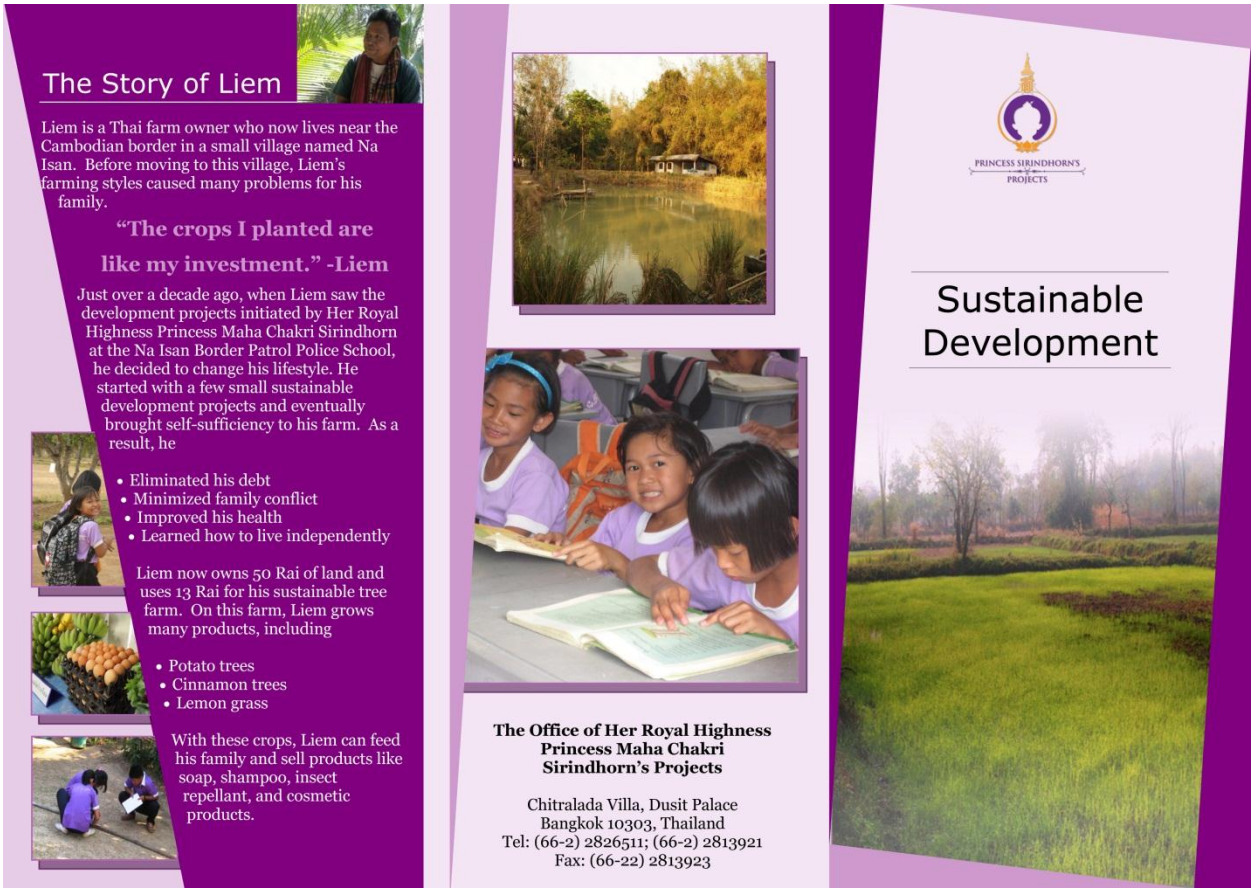

Figure 7: The front side of the English Overview brochure that was created by the project team for educators who visit demonstration sites with sustainable development.

Figure 7 shows one of the effective English brochures that the project team developed, assessed and revised in order to reach their final product. This brochure is used to sell the idea of

sustainable development to educators. The color purple was selected because it represents Her Royal Highness Princess Maha Chakri Sirindhorn, and the photos in this brochure are tinted in purple, such as the picture on the title flap of this brochure. This makes the brochure more appealing because it unites each picture with the background of the brochure and is easier on the reader. The project team included images of happy students who are thriving in their community to visually capture the reader's attention and develop a connection. These square pictures are all aligned with text or with each other in order to direct the reader's eye. This arrangement adds a level of professionalism to the brochures and allows for a more visually stimulating product.

The project team also developed a connection to the reader by telling a personal story on the left-most flap in Figure 7. This helps make the projects seem more feasible to the educators who read the brochures and gives them a specific example of someone who really benefitted from sustainable development. During their assessment, the project team learned about the importance of including quotes from students who enjoyed participating in the topic. Therefore, in order to further develop a connection between the readers and the sustainable development practices, the project team decided to include quotes in all of their brochures.

Once a connection was established, the project team used a combination of full sentences and bullet points to convey their information. They separated each flap of the brochure into several different categories using titles in a larger and easy to read font. This prevents the reader from getting bored of the information and maintains their attention throughout the time that they read the brochure. The content of this brochure describes how much the educators who read it could benefit from using sustainable development at their own schools. This content is written in an inspiring manner so that the educators will read the brochure and feel the need to return to their own schools and implement sustainable development projects there. The team found that the assessment greatly improved the layout and content of this brochure.

Figure 8: The inside of the Thai Wood Vinegar brochure that was developed by the project team for educators who are interested in implementing a wood vinegar project at their own school.

Figure 8 is an image of the inside of the Thai wood vinegar brochure that was developed by the project team. Each of the Thai brochures that the project team developed on wood vinegar, biofertilizers and biogas are laid out in this format but in a different color for each project. The team used green for the wood vinegar brochure, blue for the biofertilizers brochure and orange for the biogas brochure. The color green was selected for this brochure because wood vinegar is a sustainable development project that promotes environmental awareness and green is also one of the most common colors that the team noticed in their genre analysis. This color will appeal to educators who read this brochure because it quickly captures their attention and is still easy to read. As seen on the top of this brochure, the project team used circular images to appeal to the Thai educators and included shades of green in these images in order to make the brochure more visually appealing.

This brochure focuses on the benefits and procedures of the wood vinegar project and therefore these components form the content of this medium. By including this information, educators can return to their schools and know exactly what steps they need to follow to build and use a wood vinegar kiln of their own. The team chose to include a diagram on the center flap of this brochure to refer to when building the wood vinegar kiln to help the reader visualize their end product. In order to ensure that the brochure is easy to read, the project team selected the appropriate font size based on the research that they performed in Section 5.2.1. The size varies from the title to the body of the brochure. The font size was increased after the project team's assessment and is now easier for the target audience to read. As with the English brochure in Figure 7, the project team chose to include a personalized quote from a student to connect with the educators who read it. By developing this connection, the brochures make the reader realize that sustainable development is not just an idea to read about, but it is a practice that can be implemented and used to improve the quality of life in a community.

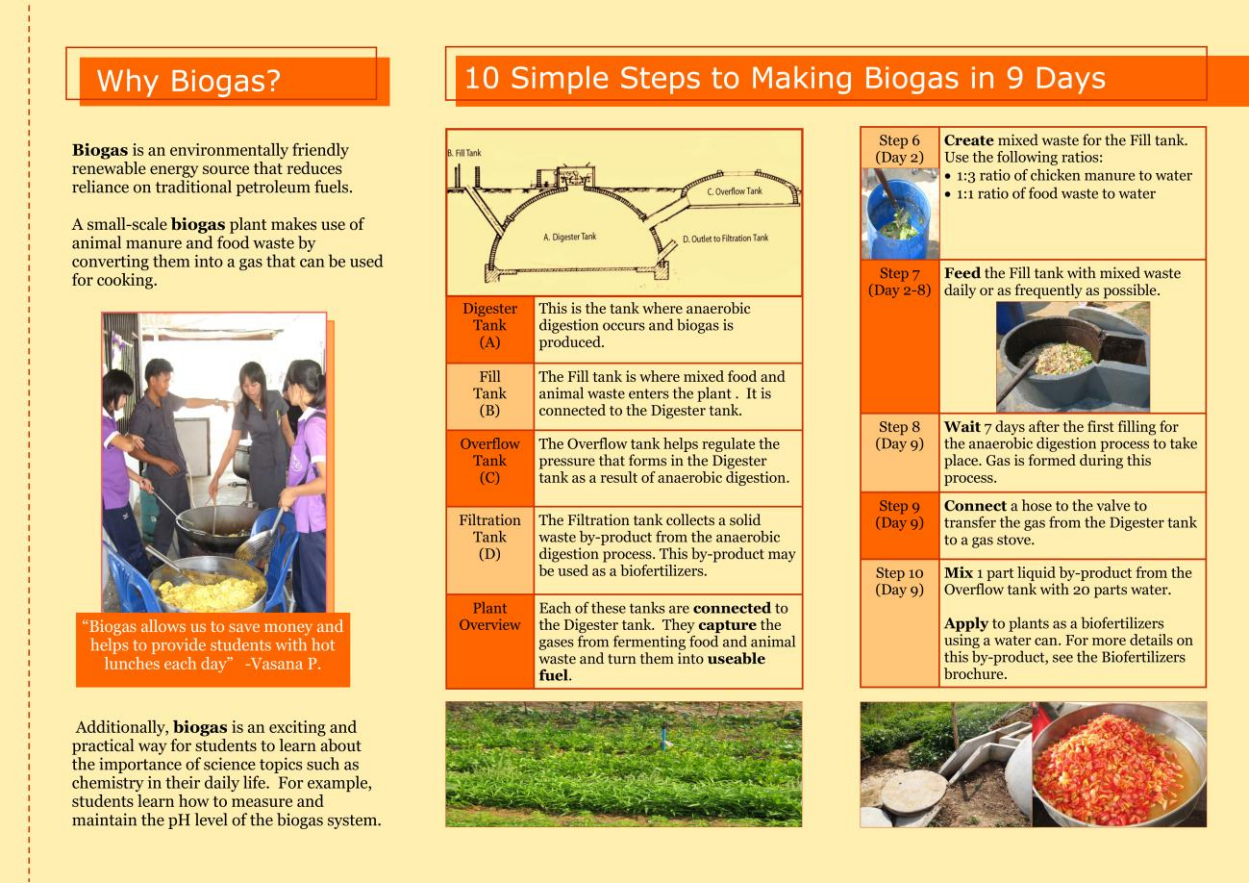

Figure 9: The inside of the English Biogas brochure that was developed by the project team for educators who are interested in implementing a biogas project at their own school.

Figure 9 above shows the inside of the English biogas brochure that the project team developed. As with the Thai brochures on the three sustainable development projects, the English brochures are all made in the same general layout, but with different colors and content. Again, this creates a theme between the brochures and also makes them easier to distinguish between. The team used the same colors for each of the projects as they did in the Thai brochures in order for the target audience to easily connect each of the brochures to one another. The team used rectangles to accent the text in this brochure because the genre analysis proved that westerners are attracted to this style.

One of the strengths of all of the brochures on the three sustainable development projects is the ability to clearly convey the procedures for each project. As the team learned in their research from Albarracin (2003) in Section 2.3.3, brochures are too short to convey sufficient information on a project and are a difficult way to teach a topic. The team overcame this

weakness in brochures by using a table to convey their information as shown on the two center and right flaps of Figure 9. During their genre analysis, they learned that this is one of the best ways to convey a step-by-step process. In their assessment with teachers and students at the Na Yao schools, the team learned that their brochures effectively teach each step of making wood vinegar, biofertilizers and biogas. The team included several content related questions on the sustainable development projects and an average of ninety two out of ninety nine of the participants answered those questions correctly (Appendix F).

The project team adjusted the prototypes of their media according to the comments that they received from their assessment subjects and developed a more effective series of informational brochures. These revisions minimized information gaps in the media and addressed the concerns that the subjects expressed with the layout and design of the brochures. The final result of these revisions was a completed set of eight informational brochures in Thai and in English on the sustainable development projects at the Na Yao schools that can be applied to similar demonstration sites throughout Thailand. All of these brochures convey the information in a concise manner which can be supplemented with videos on the same topics. In the project team's research in Section 2.3.3, they learned that brochures and videos complement each other and that the information that does not need to be conveyed in a brochure can be incorporated into a video. Therefore, the team decided to develop a series of videos on each of the projects in addition to their brochures.

6. The Development of Educational Videos

In addition to the use of informational brochures, the details of the sustainable development projects can effectively be communicated to educators through the use of educational videos. The Office of H.R.H. requested that the team produce three videos on the wood vinegar, biofertilizers and biogas projects at the Na Yao schools to benefit the educators who visit these demonstration sites throughout Thailand. The project team created these videos in both English and in Thai so that they can be used by visitors with a variety of backgrounds. To maintain consistency in their methods, the project team used the APGAR method in order to develop an effective series of educational videos. The phases of the APGAR method include analyzing, planning, generating, assessing and revising educational videos.

The specifics of how to carry out the three sustainable development projects can be explained through the use of educational videos. Educators who visit the Na Yao schools and similar demonstration sites can bring these videos back to their academic institutions and use them as a guideline for creating similar projects. This chapter describes how the project team used the APGAR method to develop an effective series of educational videos. The implementation and analysis of each of the five phases of APGAR are described below.

6.1 The Analysis Phase for Designing Educational Videos

The main components of the analysis phase include identifying the target audience and developing an effective task list that the team can follow to create an effective educational video. After speaking with representatives from the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects, the team identified the same target audience as they did for the brochures. The target audience is educators who visit the Na Yao schools and similar demonstration sites throughout Thailand. Next, the project team identified an appealing way to convey the desired message to the educators so that the videos appeal to them. The team proceeded by making a task list and deciding what they needed to complete in order to follow the APGAR method. The project team decided that they needed careful planning and a video script for each of the three films in order to complete all of their filming during their second trip to Na Yao and then edit the videos for the remainder of their time in Thailand.

6.2 The Planning Phase for Designing Educational Videos

Before generating any educational videos, the purpose, content and structure must be decided and conveyed through the use of a detailed video script. The educational videos have the same purpose as the informational brochures that the team developed. However, they lend themselves to more detail than a brochure does. They will be used to educate the teachers who visit the demonstration sites on self-reliance and environmental awareness so that they can return to their academic institutions and implement similar projects (Office of H.R.H., Personal Communication, January 18, 2011). In addition, the content of the videos is similar to that of the brochures. Fortunately, since videos have more time available to describe each aspect of the projects than the brochures did, every step of the procedure is given in detail (Office of H.R.H., Personal Communication, January 18, 2011). The benefits of each of the projects are also described in the videos in order to inspire educators to start their own sustainable development projects. The team learned about the procedures and benefits of the projects while at the Na Yao schools and during their interview with representatives from the Office of H.R.H. To ensure that the videos developed in an established and successful way, the project team conducted a prescriptive and descriptive genre analysis of educational videos that pertained to making films. This genre analysis allowed the team to develop the criteria that are explained in the following section and write a script that was used to film each shot of the video.

6.2.1 The Development of Criteria for Videos

In order to design an effective series of educational videos, the team needed to discover the commonalities between similar types of educational videos. The project team performed a genre analysis in order to create several criteria for making educational videos. These criteria define the structure, shot choice and film length for the educational videos that the project team designed and are briefly described in Table 5. The project team emphasizes the importance of understanding each of these criteria individually before moving into the generation phase. By closely investigating each criterion, the team developed a series of videos that appeal to educators who visit demonstration sites like the one in Na Yao.

Criteria	Western and Thai Styles
Structure	-Prepare the viewer -Direct the viewer's attention -Provide the viewer participation -Provide feedback to the viewer -Provide repetition
Shot Choice	-Vary vantage point -Vary shot length
Film Length	-Total of 10 minutes

Table 5: A brief description of the three criteria for creating educational videos that were identified during the project team's genre analysis of videos.

The structure of an educational video follows a standard format so that the information within the video can be conveyed in a clear and detailed manner. There are five main components in the structure of an educational video. They are to prepare the viewer, direct the viewer's attention, provide the viewer with participation, provide feedback to the viewer and provide repetition. Each of these five structural components works together to teach the viewer about a topic like sustainable development. The project team learned that in order to captivate their audience, they need to relate to them on a personal level, just like with the brochures. The videos use basic vocabulary on the benefits and procedures for each project that inspires the viewer to adopt sustainable development. This establishes a connection between the viewer and the video which makes it more likely for the viewer to implement these practices. The goal of these videos is to sell sustainability. The content of them does so through using stimulating audio recorded on a sophisticated microphone and appealing visuals of smiling children who are participating in the projects. The videos also use language that instills a sense of want in the audience. For example, each video concludes with a rhetorical question that asks the viewer why they would not implement that project. This tactic creates a sense of need in the viewer.

The five structural components allowed the project team to include all of the necessary content while still following an effective method. These components are based off of the educational media framework laid down by video analyst Wim Westera (1995) and supported by the project team's genre analysis. The first component of structure is to prepare the viewer. According to video designers Fleming and Levie (1985), learning processes are more effective when viewers have been well prepared for their learning tasks. In the genre analysis, the team learned that in order to prepare the viewer, they can present highly aesthetic visuals and sounds that are appealing to the target audience in the start of the video. Next, video researcher Postman (1986) suggests that the team direct the viewer's attention. Films can sometimes overwhelm their audiences with information, so to ensure that the viewer's attention remains fixed on the information that is presented, the project team used framing and camera movement. These two techniques were observed in the genre analysis. In addition, text is displayed to focus the audience on specific events. For example, when the videos present ratios of wood vinegar to water, the values appear on the screen and are repeated in the audio. These techniques create variety in the video and maintain the viewer's attention throughout the duration of the film.

Third, the video must provide the viewer with participation. Active involvement promotes learning amongst a group of people. The project team used Participatory Action Research to include participation in their videos. PAR allows for the viewers to identify with the students and educators who are in the film and can be used to inspire a sense of participation. The fourth component of structure is to provide feedback to the viewer. Feedback describes how the viewer discovers information since it is crucial to prevent viewers from forming misconceptions. Natural feedback is used when the film uses a scene, shot or object that raises expectations on a product or process. This allows for viewers to generate their own ideas on a topic and then clarify them with explanation in the film. Direct feedback is a method where the film and audio tell the viewer the exact information that they need to know. Based on the results of the genre analysis, the project team used a combination of natural and direct feedback to teach the audience about the procedure and benefits of the three sustainable development projects. The final component of structure is repetition. Repetition of essential information is often necessary to prevent viewers from being left behind. In the genre analysis, the project team discovered that they retained more information and understood the topic better when it was repeated in a different way. The project team used literal repetition in the narration of the educational videos

to minimize confusion amongst the viewers. After four or five procedural steps were described, the project team included a slide that lists out each of those steps in writing. This allows for the steps to solidify in the viewer's mind.

These five steps of the structure of a video are met through the division of content in educational videos. The content of the videos follows a format that was developed by the project team after the genre analysis. In the genre analysis of video introductions, the project team learned that a twenty second video clip that focuses on highly aesthetic images and music is often played. The team included a common introduction in each of their videos to tie their otherwise independent films together. According to videographer Westera (1995), this enables the project team to provide a framework and establish expectations in videos subsequent to the first one.

Following the introduction, the team included a two to three minute description of the project's benefits, which uses colorful images and creates a generally good feeling within the viewer. This method is not specifically noted in genre analysis since the content of the assessed videos was different, but the team did notice that the videos seem to make an attempt at inspiring people and capturing their attention before moving on to instruction. This component of the film establishes why the viewer should be watching the video and is connected to preparing the audience for the film. Fleming and Levie (1985) state that if the viewer is prepared in such a manner, their ability to learn is increased. The focus on highly aesthetic images and music in both this section and the introduction help capture the audience's attention, which, based on Westera (1995), instills curiosity in the viewer for the remainder of the film.

Following this component, six to eight minutes of instruction on the project's procedures are provided. The goal is for viewers to be able to reproduce the project described using only the information contained within this part of the film. This section of the film meets the requests of the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects. However since most people are only capable of storing seven concepts in their short-term memory, video researcher G.A. Miller (1963) discovered that a thirty second summary of each step should be included after seven steps are introduced to the viewer. Multimedia analyst Salomon (1981) stated that pictures and words should be combined to convey the same message; therefore text appears on the screen after these steps. This text repeats what the viewer has just learned. If a suitable place to break occurs, such as a topic change, then the summary occurs at that point in

the film. Genre analysis showed that this reinforces the steps of the projects and allows for the viewer to digest the topics better.

The video concludes with a one minute summary of both the instructions and benefits of the projects because the project team learned from their genre analysis that a conclusion to the film allows for the viewer to fully understand the topics. Based on Postman's research (1984) viewers can often become overwhelmed with the volume of information presented. Additionally, Westera (1995) claims that the viewer must be given adequate breathing room to process and analyze the information. This summary reinforces the procedure and explains why these steps are relevant. According to Fleming and Levie (1985), this repetition increases information retention. The project team used summaries in their videos to help the viewer understand the videos.

The second criterion for creating an educational video is shot choice because an effective educational video requires a variety of types of shots. In the genre analysis, the team discovered that the shot distance, vantage point and length need to be varied. Video analyst Telg (2009) states that this helps maintain the audience's attention for the duration of the film. In order to vary the type of shot, the project team included three dimensional images to describe how to build the wood vinegar and biogas structures. These graphics use modern software to show the structures from all angles. They prevent the project from seeming like a feat of engineering and allow for the viewer to visualize the product that they will be building. To show the inside of a 3-D object, the project team uses cross sections. According to Perkins (2009), cross sections are a great way for scientists and engineers to see how a building or structure appears during the construction process. With the use of 3-D graphics and cross-sections, the project team included variety in their shot choice and inspired the audience to practice sustainable development.

The final criterion for designing educational videos is that the total length of the film should be ten to fifteen minutes in order to maintain the viewer's interest on the topic. This length was requested by the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects. Research from film researcher Champoux (1999) supports this request because a ten to fifteen minute long film is the maximum length of time that audience's attention can be captured before it begins to wane (p. 10). When the project team wrote their video scripts, they made sure that a ten to fifteen minute time limit was taken into account.

6.2.2 Video Script

The final component of the plan phase is to create a script for the videos that clearly describes every film clip, which direction it is taken from, how long it lasts and what audio is included in that scene. The project team's video script was written in a table format that is recommended by Telg in his article, *Producing Your Own Video Program* (2009). This research shows that the left column provides the duration of each clip, the middle column includes specific camera shots and special effects, while the right column describes all audio requirements including narration or other dialogue. After visiting the village for the first time and learning about each of the three sustainable development projects through observation and participation, the team began to write these detailed video scripts. These scripts were designed using the information collected in in Na Yao and from the Office of H.R.H. They were written in both Thai and in English in order to accommodate the wide range of people who visit the Na Yao schools. The script for each video can be found in Appendix G.

6.3 The Generation Phase for Designing Educational Videos

Once the script was written, the project team moved into the generation phase of the project, which is comprised of filming and editing. This allowed the team to design a prototype of the media. The filming of this project was completed on the team's second trip to the Na Yao schools. Each of the team's seven project members participated in the filming and staging for the video clips. The videos contain information in a format that appeals to educators and conveys the benefits and procedures of wood vinegar, biofertilizers and biogas. The main component of this phase included editing the clips of footage that the team collected. The project team used three types of professional software called Adobe After Effects, Adobe Premiere and Adobe Photoshop Extended to edit the videos. These videos will promote sustainable development to educators from other remote areas in Asia and will benefit the people in these communities. The educators will learn how to start with a small sustainable development project and build upon that to improve their health, save money and provide food for themselves and their families.

6.4 The Assessment Phase for Designing Educational Videos

As with designing brochures, an assessment is needed to evaluate the initial media design and determine how effective it is. However, because of time constraints, the project team could

not assess the educational videos with the target audience, as suggested by media expert Bear. If the team did have time, they would use a questionnaire to effectively evaluate the videos. In a study performed by Chan, Fox, Lavery and Kwon (2008) researchers interpreted the effects of an educational video on "Emergency Departments Patient Stroke Knowledge," in which they studied subjects who passively watched a stroke videotape in the emergency department waiting room and determined what they learned from these videos through the use of a questionnaire in the form of a short quiz. Based on this research the team chose to make an assessment quiz on the content of the videos to see if their designed media serves its purpose. The participants in Chan's study received a thirteen question quiz before and after watching the educational videos. According to Chan et. al. (2008), these quizzes included multiple choice or yes/no questions. Chan et. al (2008) recommend that the quiz focuses on what the subjects learned in the video to determine if the message was clearly portrayed. Despite the fact that they could not assess the media with educators, the project team devised an assessment quiz which can be found in Appendix H for future use.

Instead, the project team assessed these educational videos with representatives from the Office of H.R.H. and the project advisors. The team provided samples of the educational videos to these subjects, and they received feedback on their content and design. In this assessment, the team learned the importance of appropriate transitions, an appealing color balance and clear audio. The team also learned that adding more captions and text to the video can reinforce the audio instructions with a visual component. The Office of H.R.H. requested that the team visually introduce a task before showing it. The project team took all of these recommendations into account, as well as some advice on clip selection and length, in the revision phase of the design process.

6.5 The Revision Phase for Designing Educational Videos

After the verbal assessment with advisors and representatives from the Office of H.R.H., the project team addressed the weaknesses of their educational videos. In this quality check, the team made sure that the videos meet the goals of the Office of H.R.H. The main revisions that the project team addressed are:

- repetition slides
- text that clearly displays lists
- transitions
- title slides for new sections of the procedure
- 3-D imaging
- clear audio

Each of these revisions is described in this section of the report. They make the video more attractive to the educators who will watch them. They help the viewer fully understand the sustainable development projects and minimize distractions. They also allow the reader to process the information in two different ways, through sound and through sight. The project team emphasizes the importance of these components to their revision phase because they helped unify the videos and avoid confusion amongst the audience.

Figure 10: A review slide from the biofertilizers video that summarizes the steps taken to make the micro-organisms needed for biofertilizers.

In order to include repetition in their videos, the team used slides in the format shown in Figure 10 above. This helps the viewer retain the information stated in the previous clips. Adding review slides reinforces research from Salomon (1981) that states that the use of multiple forms of visual aids, such as text and video images, is much more effective than using one medium. Research by video analyst G.A. Miller (1963) shows that repeating each step of the process in several concise slides inspires more educators to implement their own sustainable development projects. Repetition helps the viewer remember the project, which in turn makes them more likely to want to practice sustainable development on their own.

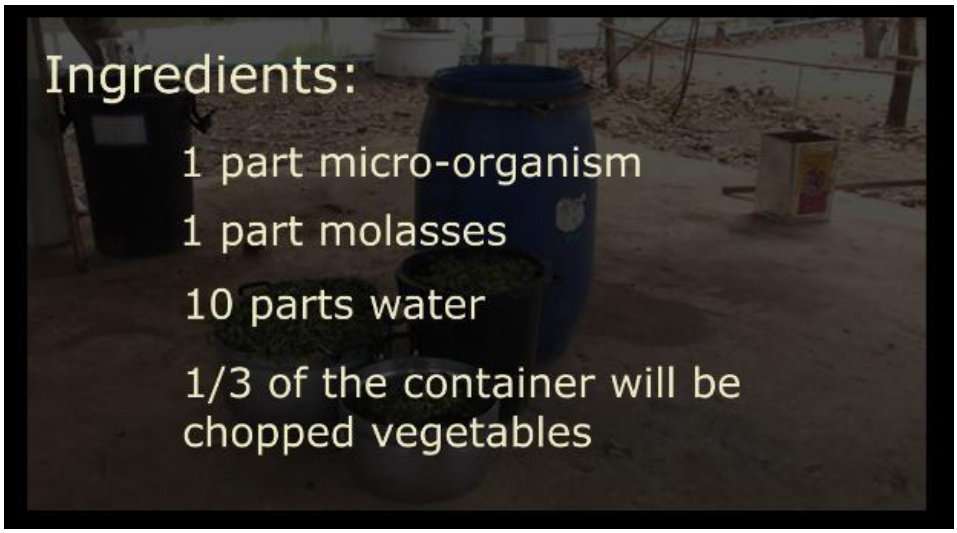

Figure 11: A concise list of the ingredients used to produce biofertilizers from the project team's Biofertilizers video that helps the reader visualize the materials needed.

Figure 11 above shows a shot from the film where the team listed out all of the ingredients that are used in the steps following that video clip. Throughout each of their videos, the team used text to supplement any audio consisting of lists or measurements. This allows for the viewers to both see and hear the components of the list that are included in each process and retain the information better. This style was adopted after the project team's video assessment. It helps prepare the viewer for the upcoming video clips, which is one of the components of the structure criteria that the project team identified in their genre analysis.

Figure 12: A cross dissolve transition used in the project team's Biofertilizers video that adds a level of sophistication to the videos.

From the assessments, the project team learned that using simple and smooth transitions is highly recommended. Therefore, cross dissolves, as shown in Figure 12, were used to transition between video clips. In this figure, the image in the middle is in the process of a

transition and both the water and molasses are visible. This tactic prevents any distractions made by unprofessional transitions and maintains the viewer's attention.

Figure 13: A title slide from the Biofertilizers video that gives the audience time to prepare for the upcoming footage.

As per the requests of the Office of H.R.H., the team added visual representations of the general tasks to be completed. Figure 13 above shows a simple title slide in the biofertilizers video that precedes the step-by-step process involved in cultivating the micro-organisms. These slides appear throughout the videos and give the viewers short breaks, providing them with time to process what they have just learned and prepare themselves for the upcoming information. Video designer Westera (1995) suggested that providing the viewer with time to process the film helps the viewer retain the information that they just gathered.

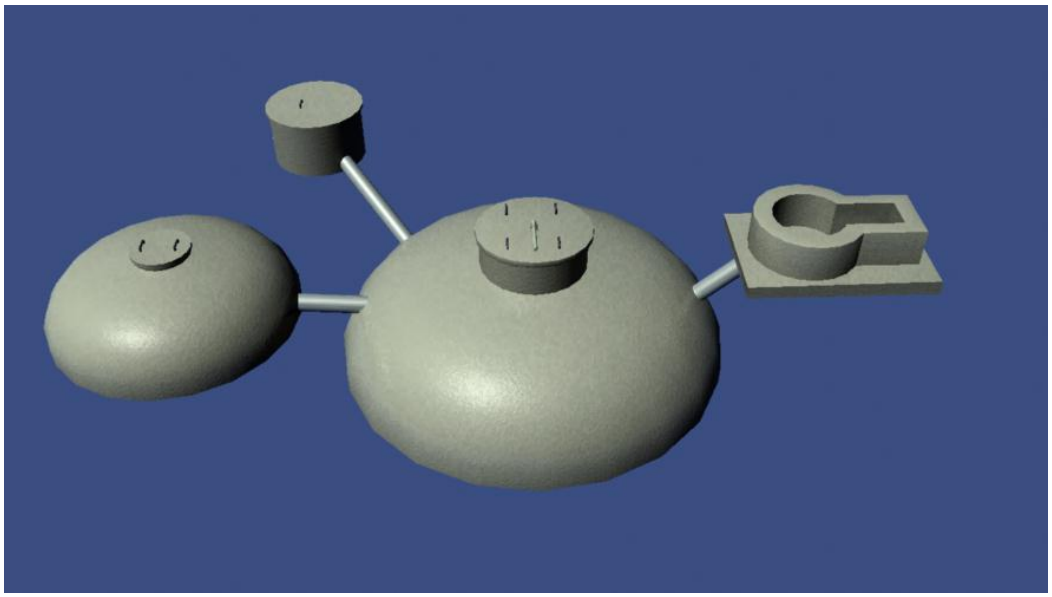

Figure 14: A picture of one of the three dimensional drawings used to describe how educators can build their own biogas system.

While developing their videos, the project team realized that they did not have any means of showing how to build the wood vinegar kiln or the biogas tanks, since they were already constructed and in use at the Na Yao schools. In order to overcome this difficulty, the project team used three dimensional drawings to show the construction process. Figure 14 above shows one of these three dimensional drawings for the biogas system. By using this technology, the videos still effectively convey each step of the procedure to the educators who will be viewing them. This tactic helps the educators understand each step of the construction process since they can watch it and visually comprehend everything.

Along with the visual component, the audio of a video is important to the assessment and revision phases. The project team accessed professional audio equipment that was used to record the scripts written for each of the three videos. In the genre analysis, the team discovered that using a loud, clear voice spoken in a monotone yet animated manner captures the audience. The team concluded that this is how most instructional videos are narrated. Additionally, according to telecommunications professional Mason (1994), "background sounds, which in face-to-face communication the listener can easily distinguish from direct speech, are the major nuisance in transmitted sound" (p. 63). Therefore, the project team avoided using background sounds in their videos. The high quality of the audio in the videos adds a level of professionalism to the final product.

During the revision phase of this project, the team discovered useful information on how to effectively develop a series of educational videos that convey the benefits and procedures of wood vinegar, biofertilizers and biogas to educators. The project team suggests that future media developers revise their media using the information collected in assessment quizzes in order to develop a final product that is tailored more towards the educators who visit demonstration sites like the one in Na Yao. These assessment quizzes can be found in Appendix H of this report.

6.6 Outcomes of the Development of Informational Media

The educational videos and informational brochures can be used at the Na Yao schools and similar educational demonstration sites throughout Thailand. These completed media will benefit educators who visit the demonstrations sites and teach them about wood vinegar, biofertilizers, biogas and the innovations that can be made to their curriculum. These eight tri-fold brochures and six ten-minute videos introduce the various sustainable development projects to the educators who visit the schools. They also provide a material aid with instructions on the procedures and benefits of each project to the visitors. By teaching educators about sustainable development, these media will help educators improve the quality of life at their own schools and promote self-reliance throughout Asia.

7. Conclusions

This report led to the development of an effective series of eight informational brochures and six educational videos in Thai and English on the benefits and procedures of wood vinegar, biofertilizers and biogas. These media can be used to disseminate knowledge on sustainable development projects to educators from Thailand and neighboring Asian countries to help spread environmental awareness and self-reliance. The brochures provide concise information on each of the projects that quickly get the message across and overview the opportunities that sustainable development can provide a community with. The videos complement the brochures and visually provide specific details on the procedures and benefits of the projects in a way that cannot be done in a tri-fold brochure. These two forms of media work together to spread sustainable development to educators who visit the demonstration sites in Thailand. Additionally, this report can be used as a guideline for developing media in the future.

Based on the results of their research, the project team created three significant conclusions to developing media. These conclusions focus on the importance of:

1. Developing relationships with the project coordinators
2. Determining the message and goal of the media
3. Planning and assessing the media

These three conclusions helped the team develop their media for the desired target audience. The team learned how important it is to complete these components before designing their media. Each of these conclusions are described in this chapter and related back to the project goal of disseminating information on sustainable development to educators who visit the educational demonstration sites throughout Thailand.

7.1 Develop Relationships with the Project Coordinators

Prior to filming or photographing any of the subjects in the brochures and videos, the project team spent time developing a relationship with them. The project team took two trips to the Na Yao schools, which is where their media was produced. During the first of these trips, the project team had the opportunity to meet the students and teachers who they would be photographing and filming. The project team gained valuable insight on how to act in this unique village and learned how to be sensitive to a new culture. On their second trip to Na Yao, the project team was able to successfully photograph and film their subjects. The participants

seemed to appreciate that the project team had taken the time to learn about the Thai culture and adjust to their surroundings. The team realized how important developing these relationships was to the success of their media. Without these relationships, the project team would not have had the opportunity to film the Na Yao students and teachers performing each project, and they would not have had the opportunity to assess their brochures in the desired setting. The project team is grateful that they were given a chance to learn about the culture in this rural village and develop relationships with the people there.

7.2 Determine the Message and Goal of the Media

Before designing their brochures and videos, the project team realized the importance of determining the message and the goal of the media. The team needed to understand what these media should convey prior to making them. Without this step, the project team could have developed a series of media that may be appealing, but would have incorrect content. Through interviews with representatives from the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects, the team discovered that the media should promote self-reliance, the benefits of sustainable development, and the procedures for these practices to educators who may be interested in making their own projects. The team navigated this complexity by performing a genre analysis to learn how to convey this type of information in brochures and videos. The team learned that brochures often use a table to convey procedures, while videos use step-by-step instructions for the entire process. In their genre analysis, the team discovered that the benefits of the projects should be one of the first things that the audience sees; therefore, each brochure has the benefits on their first inside flap, and each video starts with the benefits of the project. By structuring the media in this manner, the project team developed an effective series of brochures and videos that disseminate knowledge on sustainable development and self-reliance to educators.

7.3 Plan and Assess the Informational Media

In designing a series of informational media, the project team realized the importance of planning and assessing the product. The team analyzed, planned, generated, assessed and revised their media during their time in Thailand. In the planning phase, the project team determined the purpose of the media and established the content. They also critiqued several samples of brochures and videos on sustainable development to develop criteria for their own

media. To develop their brochures, the project team made sure that the type, layout, shape, font, color and content were similar to the sample brochures they critiqued. Their video criteria included details on the structure, shot choice and film length. These criteria provided insight on both the content and appeal of the brochures and videos. This helped them tailor the media to the target audience and convey the message in an appealing manner.

The planning phase helped the team proceed to the generation phase and develop media that would appeal to educators more. The team generated brochures in both Thai and English so that they could appeal to a wider target audience. This increases the chances that sustainable development may be implemented. The team also used modern technology to make the videos and brochures more appealing. They used 3-D imaging to describe how to build structures and demonstrate the construction processes that had already been completed at the Na Yao schools. Additionally, the team included high quality sound in their videos by recording all of the audio in a recording studio with a highly sensitive microphone. Each of these factors allowed the team to develop media that is more attractive and inspiring to the educators who will be viewing it.

An assessment was performed with the Na Yao teachers, the WPI advisors and representatives from the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects to determine the strengths of the media and address its weaknesses. The team provided an assessment questionnaire to the people at the Na Yao schools and received excellent feedback on the brochure themes and size of the font. In their assessment with the project advisors and the Office of Her Royal Highness., the team learned about proper alignment, the use of quotations, appropriate transitions and introductory slides. The team took all of these suggestions into account when revising their media and developing a final product. The team recommends that future project teams who are developing media perform an assessment and discover the flaws in their prototypes. This phase was extremely helpful for the project team, and the designed media underwent significant revision after these assessments. As a result, the team developed a series of media that complement each other. The videos provide detail where the brochures cannot, and the brochures give quick information where the videos cannot.

7.4 Concluding Remarks

The project team hopes that this report helps the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects disseminate knowledge on sustainable development projects to the educators who visit the demonstration sites that exist throughout Thailand. The team

realizes that this research is only one small step in promoting sustainable development throughout Asia, but they hope that the media they developed can make an impact. The project team would like to recommend that the Office of Her Royal Highness continue to promote sustainable development because the benefits of these projects, even on a small scale, can greatly improve people's lives and increase the availability of resources. In the future, the Office of H.R.H. could consider developing media on some of the other sustainable development projects at the Na Yao demonstration site, such as raising pigs in mud holes or organic egg farming. Additionally, inquiry into how the media that the team developed are appropriated by the target audience once they are in use can lead to better tailoring of any new media designs. The media can help teach educators that sustainable development projects can easily be implemented at their own schools and that a higher quality of life is a feasible option. Spreading sustainable development will benefit the environment, community members and future generations of people in all parts of Asia and the world. Hunger, poverty and poor education can be minimized by using sustainable development regularly.

References

Albarracin, D., Leeper, J., Earl, A., & Durantini, M. R. (2007). From brochures to videos to counseling: exposure to HIV-prevention programs. *AIDS Behavior*, 12, 354-362.

Albarracin, D., McNatt, P. S., Klein, C., Ho, R., Mitchell, A., & Kumkale, G. T. (2003). Persuasive communications to change actions: an analysis of behavioral and cognitive impact in HIV prevention. *Health Psychology*, 22, 166–217.

Alexander, T., Israel, H., Lax, S., Lohaphansomboon, P., Saxner, D., & Srisawasdi, T. (2010). Laboratory activities for secondary science education in rural Thailand. Interactive Qualifying Project. Retrieved 30 October 2010 from http://www.wpi.edu/Pubs/E-project/Available/E-project-030410-040620/unrestricted/Science_Laboratory_Education_Final_Report_03.04.2010.pdf.

Bailey, K.D. (1994). Methods of social research. The Free Press: New York. 138-140.

Baggett, P. & Ehrenfeucht, A. (1981). Encoding and retaining information in the visuals and verbals of an educational movie. *Educational Technology Research and Development*. 31(1), 23-32.

Balit, S. (2007). Communication for isolated and marginalized groups. *Communication and Sustainable Development: Selected Papers from the 9th UN Roundtable on Communication for Development*, 101.

Bear, J.H. (1997). Guidelines to creating a brochure for a place or organization. Montana: NASA/MSU Bozeman-CERES Project. Retrieved 1 February 2011 from http://btc.montana.edu/ceres/html/MarsQuest/Quemarsbrochure.htm.

Bessette, G. (2007). Facilitating dialogue, learning and participation in natural resource management. *Communication and Sustainable Development: Selected Papers from the 9th UN Roundtable on Communication for Developme*nt, 79.

Bird, K., Hulme, D., Moore, K. & Shepherd, A. (2002). Chronic Poverty and remote rural areas. Birmingham, UK: Chronic Poverty Research Centre.

Boame, K. (2010). 25 characteristics of highly effective social media. Social Media News, Strategy, Tools, and Techniques | Social Media Today. Retrieved 15 January 2011 from http://socialmediatoday.com/SMC/203359.

Brundtland, G. (1987). World commission on environment and development. Kenya. Retrieved 6 December 2010.

Bunders, J. F. (1990). Biotechnology for small-scale farmers in developing countries. Amsterdam: VU University Press.

Champoux, J. (1999). Film as a teaching resource. *Journal of Management Inquiry*, 8(2), 240 -251. Retrieved from http://reference.kfupm.edu.sa/content/f/i/film_as_a_teaching_resource_70075.pdf

Chan, G. (2009). Seedtree's biogas program. Retrieved November 8, 2010, from Seedtree: http://www.seedtree.org/biogas.html

Chan, Y., Lavery, R., Fox, N., Kwon, R., Zinzuwadia, S., & Massone, R. (2008). Effect of an educational video on emergency department patient stroke knowledge. *Journal of Emergency Medicine*, 34 (2), 215-220.

Chuenchit, W. (2009). HIA for HPP. National Health Commission Office. Chiang Mai, Thailand.

Clark, D. (2010). Instructional system design (ISD) handbook (ADDIE). Retrieved January 30, 2011, from http://www.nwlink.com/~donclark/hrd/sat.html

Di Blas, N., Paolini, P., & Rubegni, E. (2010). How to build multi-media and multi-channel corporate brochures. Proceedings of IPCC 2010, *The International Professional Communication Conference.* Netherlands.

Dozier, D. M., & Ehling, W. P. (1992). Evaluation of public relations programs: What the literature tells us about their effects. *Excellence in Public Relations and Communication Management*, 159-184.

Driscoll, D. (2005). WRT 101: genre analysis and comparisons. WRT 101 Curriculum: Fall 2005.

Duermyer, R. (2011). What you need to know before printing a brochure. New York: New York Times Company. Retrieved 1 Feb 2011 from http://homebusiness.about.com/od/marketingadvertising/a/brochure_tips.htm.

Fleming, M. & Levie, W.H. (1985). Instructional message design. New York: Holt, Rinehart and Wiston.

Frost, J. & Marx, R. D. (1998). Toward optimal use of video in management education: Examining the evidence. *Journal of Management Development*. 17(4), 243-250.

Garrovillas, E.P. (2005). An integrative review of education and socio-economic data in South East Asia, South Asia, and East Asia. *European Journal of Scientific Research*, 11(3), 371-383.

Gilbert, V.C. (1983). Co-operative Regional Demonstration Projects: Environmental education in practice. *The George Wright Forum*.

Global Healing Center. (2010) Benefits of organic wood vinegar. Retrieved: 9 Nov. 2010, from Global Healing Center: Natural Health & Organic Living: http://www.globalhealingcenter.com/wood-vinegar.html.

Halsall, P. (1997). Modern history sourcebook: Tables - Spread of Industrialization. Retrieved 27 Nov. 2010 from http://www.fordham.edu/halsall/mod/indrevtabs1.html.

Hannafin, M.J. & Hughes, C.W. (1986). A framework for incorporating orienting activities in computer-based interactive video. *Instructional Science*, 15, 239- 255.

Haury, D.L., & Rillero, P. (1994). Perspectives on hands-on science teaching. Columbus, OH: The ERIC Clearinghouse for Science, Mathematics, and Environmental Education.

Hopfner, D. & Rey, J. (2009). An educational brochure to reduce the risk of infection in the hospital setting: Knowledge assessment and acceptance from patients. American Journal of Infection Control. Vol. 35 No. 7.

Huesca, R. (2003). Participatory approaches to communication for development. International and Development Communication: A 21st Century Perspective, 209-226.

Huston, A. and Wright, J. (1983). Children's processing of television: The informative functions of formal features, in Bryant, J. and Anderson, D.R. (Eds), Children's Understanding of Television. New York: Academic Press.

Kaufman, P. B. & Mohan, J. (2009). Video use and higher education: Options for the future. Retrieved from http://library.nyu.edu/about/Video_Use_in_Higher_Education.pdf.

Kindon, S., Pain, R. & Kesbey, M. (2007). Connecting people, participation and place: participatory action research approaches and methods. London: Routledge.

Klapper, J. T. (1960). The effects of mass communication. Glencoe, IL: Free Press.

Koumi, J. (1991). Narrative screenwriting for educational television: A framework. *Journal of Educational Television*, 17(3), 131-148.

Kozma, R.B. (1991). Learning with media. *Review of Educational Research, 61*(2), 179-212.

Manno, J. & Whaley, R. (2010). Sustainable development. PollutionIssues. Retrieved 6 December 2010 from http://www.pollutionissues.com/Re-Sy/Sustainable-Development.html.

Marker, C. (2005). Market review: Having fun with the details. Retrieved 4 February 2011 from http://www.lexisnexis.com/hottopics/lnacademic/?verb=sr&csi =8406&sr=lni%284G1M-JRN0-004X-82CY%29.

Mason, R. (1994). Using communications media in open and flexible learning. London: Routledge.

McLamb, E. (2008). The industrial revolution and its impact on our environment. Ecology Today. Retrieved 27 November 2010f from http://ecology.com/features/industrial_revolution.

Miller, D.C. & Salkind, N.J. (2002). *Handbook of research design & Social measurement*. California: Sage Publications.

Miller, G.A. (1963). The magical number seven plus or minus two: Some limits in our capacity for processing information. Psychological Review.

Moisiadis, F. (2002). The fundamentals of prioritizing requirements. Sydney, Australia: Test & Evaluation Conference.

National Economic and Social Development Board. (2004). Sufficiency economy. Bangkok. Retrieved 25 February 2011 from www.sufficiencyeconomy.org/old/en/files/4.pdf.

National Economic and Social Development Board. (2006) Summary: The Tenth National Economic and Social Development Plan (2007-2011). Bangkok. Retrieved 3, December 2010, from http://whothailand.healthrepository.org/bitstream/123456789/588/1/Summary_10th%20National%20Economic%20Social%20Development%20Plan%20%282007-2011%29.pdf.

Office of H.R.H. (2011). *School profiles: Na Isan Border Patrol Police School and Phrarachathan Na Yao Secondary School.*

Pearce, D.W. (1993). *Blueprint 3: Measuring sustainable development*. London: Earthscan Publications Limited.

Perkins, C. (2009). Photoshop CS4 Extended for video. Lynda.com. Retrieved 21 February from http://www.lynda.com/tutoriallanding/53410.

Postman, N. (1986). Amusing ourselves to death: public discourse in the age of show business. New York: Penguin.

Professional Advertising. (2005). Effective brochure design: How to create brochures that get action. Professional Advertising. Retrieved 2 February 2011 from http://www.myprofessionaladvertising.com/Effective%20Brochure%20Design.ht m.

Ramírez, R. (2003). Bridging disciplines: The natural resource management kaleidoscope for understanding ICTs. *Journal of Development Communication*, 14(1), 51-64.

Robertson, T. S. (1967). The process of innovation and the diffusion of innovation. *The Journal of Marketing*, 31(1), 14-19.

Saksit &Junpen. (2011). Leaflets. Retrieved 7 January 2011 from http://gotoknow.org/blog/viscom1/225891.

Salomon, G. (1981). The differential investment of mental effort in learning from different sources. Jerusalem, Israel: The Hebrew University of Jerusalem.

Skinner, C., Campbell, M., Rimer, B., Curry, S., & Prochaska, J. (1999). How effective is tailored print communication?. *Annals of Behavioral Medicine*, 21, 290-298.

Slavin, R.E., (1999). Disseminating Success for All: Lessons for policy and practice. Maryland: Johns Hopkins University.

Telg, R. W. (2009). Producing your own video program. Retrieved 19 January 2011 from http://edis.ifas.ufl.edu/wc022.

The World Bank. (2010). Thailand environment. Retrieved 27 November 2010. http://go.worldbank.org/T2J5F487W0.

Trochim, W. (2006). Likert scaling research methods: Knowledge base. Web Center for Social Research Methods. Retrieved 31 January 2011 from http://www.socialresearchmethods.net/kb/scallik.php.

UNDP. (2010). Thailand: Environmentally sustainable development. Retrieved 13 November 2010 from United Nations Development Programme: http://www.undp.or.th/focusareas/environment.html.

UNESCO. (2009). Her Royal Highness Princess Maha Chakri Sirindhorn. United Nations Educational, Scientific and Cultural Organization. Retrieved 23 January 2011 from http://portal.unesco.org/en/ev.php-URL_ID=26434&URL_DO=DO_TOPIC&URL_SECTION=201.html.

UNESCO. (2010). About UNESCO. United Nations Educational, Scientific and Cultural Organization. Retrieved 21 February 2011 from http://typo38.unesco.org/en/unesco-home/organization/about-unesco-srtct.html.

UNESCO. (2011). Good practice examples of ESD. Retrieved 21 February 2011 from UNESCO Bangkok: Education for Sustainable Development Unit: http://www.unescobkk.org/education/esd-unit/good-practice/.

Westera, W. (1995). Audiovisual design, theory and practice: Developing concepts for film video and television. Abcoude: Uitgeverij Uniepers Abcoude.

Appendix A

Work Schedule for our time in Thailand. Split between our time in Na Yao and our time in Bangkok.

	January													
	M	T	W	R	F	S	S	M	T	W	R	F	S	S
	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sponsor Presentations														
Work in Bangkok														
Work in Na Yao														
Gather Research on Brochures and Videos														
Determine the Message of the Media														
Develop Guidelines for Designing Media														
Generate Brochures and Videos														
Assess Media														
Finalize Media														
Write Final Report														

	January													
	M	T	W	R	F	S	S	M	T	W	R	F	S	S	M
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Sponsor Presentations															
Work in Bangkok															
Work in Na Yao															
Gather Research on Brochures and Videos															
Determine the Message of the Media															
Develop Guidelines for Designing Media															
Generate Brochures and Videos															
Assess Media															
Finalize Media															
Write Final Report															

	February															
	T	W	R	F	S	S	M	T	W	R	F	S	S	M	T	W
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sponsor Presentations																
Work in Bangkok																
Work in Na Yao																
Gather Research on Brochures and Videos																
Determine the Message of the Media																
Develop Guidelines for Designing Media																
Generate Brochures and Videos																
Assess Media																
Finalize Media																
Write Final Report																

	February												March			
	R	F	S	S	M	T	W	R	F	S	S	M	T	W	R	F
	17	18	19	20	21	22	23	24	25	26	27	28	1	2	3	4
Sponsor Presentations																
Work in Bangkok																
Work in Na Yao																
Gather Research on Brochures and Videos																
Determine the Message of the Media																
Develop Guidelines for Designing Media																
Generate Brochures and Videos																
Assess Media																
Finalize Media																
Write Final Report																

Appendix B

A detailed explanation of the four goals of the National Economic and Social Development Board's plan for 2007 to 2011. Quoted from their report:

The overarching goal of the draft NSDS of Thailand to Sustainable development is to achieve economic, social, environmental balance as a basis for improvement of quality of life, provision for competitiveness of the country in the long run. Thailand's draft NSDS aims to make extensive use of economic instruments, the year plans of the National Economic and Social Development Plan (NESDP), the other existing strategy and mechanisms. Based on the 10th National Economic and Social Development Plan, the main four goals of the NSDS Thailand are:

Goal 1: Eliminate poverty through sustained and equitable economic growth

The plan is designed to strengthen the Thai society and the local communities, promote indigenous wisdom, and reform the economic structure for sustainable growth.

Goal 2: Enhance environmental security and sustainability

"Green and happiness society" Program. Increasing awareness among the communities about the environment.

Goal 3: Create a knowledge-based society and social security

Will promote self-sufficiency at all levels of the society and business community, as well as quality of life of the people, for the society to become a knowledge based and life-long learning society

Goal 4: Ensure good governance at all levels of society

The green and happiness society will be achieved by strengthening communities' capabilities, promoting public and private governance, promoting distribution of wealth, balancing economic development and increasing access to education.

(National Economic and Social Development Plan, 2006)

Appendix C

Summary of results from the interview with representatives from the Office of Her Royal Highness Princess Maha Chakri Sirindhorn's Projects.

Interview with Representatives from the Office of Her Royal Highness

January 18, 2011

Present: All Team Members, Dr. Nantaporn, Mr. Aphisit, Gift Thanawan

1. What is the purpose and form of the media?
    a. The Office would like educational videos and informational brochures on each of the projects in order to demonstrate how the technology works. These media will be used to teach the visitors how to set up a lesson plan and teach these ideas to their students. The key principle is self-reliance. Each of these media will be provided to the visitors at the end of their stay in Na Yao.
2. Where are the majority of the educators who visit the Na Yao schools from?
    a. Vietnam, Laos, Cambodia, Bangladesh, Mongolia
3. Will we have the opportunity to meet any of the visitors to Na Yao?
    a. Probably not, only 2-3 delegations of 6-7 individuals visit Na Yao per year
4. How did the projects in the Na Yao schools start? What is their curriculum?
    a. The Ministry of Energy introduced these techniques to the school and is responsible for the implementation of the wood vinegar and biogas projects.
5. How many students have gone through the curriculum?
    a. Roughly 100 to 200 Students have gone through the program, but their level of involvement varies.
6. What role, if any, does the Na Yao demonstration site play in the Office's public relations?
    a. Public relations are not the explicit goal of the demonstration site, but through educating visitors, the Office implicitly shows that the programs in Na Yao are effective. The Office cares for the school and uses it mostly as a showcase for

teaching self-reliance and sustainable development and as a result, they receive good public relations, but it is not the intention of this program.

7. What types of educators visit the Na Yao Schools and what is the purpose of their visit?
    a. The majority of those who attend the school are working within the educational system. Most of the visitors are teachers, some are educational managers, such as school principals. These foreign educators are usually less wealthy and possess a weaker curriculum than the one present in Thailand. The purpose of their visit is to learn from Her Royal Highness of Thailand since she is the educational ambassador to UNESCO. The organization, UNESCO, chose representatives from other nations to visit the Na Yao schools. They are chosen based on whether their environments are similar or not. Then the countries that are selected decide which representatives to send.
    b. The representatives come for many reasons. For example, Her Royal Highness helped a school in Burma after a storm and they went to Na Yao to promote and experience the Thai progress.
8. What did you tell visitors about the sustainable development projects in the past?
    a. Prior to this project, the instructors would give only a brief demonstration to visitors, which often left information gaps. They received a tour at the schools from the teachers that explained each of the projects.
9. What else do the visitors visit in Na Yao?
    a. Depending on the visitor, they may visit other projects at other schools. The Na Yao region focuses on agriculture, while for example, Bangkok focuses on education. Na Yao is one of approximately 700 demonstration sites in Thailand. When Mongolians want to learn about farming, so they travel to a certain part of Thailand to study the farming programs there.
10. What does the Office hope visitors will learn during their visit to the Na Yao schools?
    a. The Office hopes to teach the visitors different ways to incorporate the projects in their schools and villages in order to increase self-reliance and environmental awareness. They would like the media to include information on the procedure and the benefits of the projects in English and in Thai so that it is easier for the visitors to bring these projects back to their nations and implement the actual

processes without having to contact the Office of H.R.H. The information provided now is not enough to be brought back and successfully implement the projects. Most visitors come from remote areas that have lower educational standards. By disseminating this knowledge on self-reliance to other schools, the standard of living can be improved. Also, the Office has learned that students learn better when they are healthier, so they have decided that providing agriculture and food may be a key component of improving the health and life skills of the students.

11. Are there currently any manuals or materials distributed to the visitors? If so, do you think that the project manuals that you give to the teachers have enough information to understand and transfer to the visitors?
    a. There are currently no manuals distributed to visitors.
12. Is there any information you would suggest adding to the manual?
    a. Not relevant
13. What is the prioritized order of these three projects?
    a. Wood vinegar
    b. Biofertilizers
    c. Biogas
14. Informational Questions:
    a. How is biogas made? How is it used? Who uses it? How frequently do they have access to it? What are the benefits of using biogas? How is the production of biogas included in the school's curriculum?
        i. Presented by p'Boom Panarat
        ii. Biogas is an alternative energy source that is reusable. It uses leftover food from the schools kitchen and animal manure. The by-product can be used as biofertilizers and is collected in the overflow and filtration tanks. The biogas is connected to the kitchen stove through a rubber tube and used for cooking. The Carbon to Nitrogen ratio must be appropriate in order for the gas to be effective. This reduces the schools cost of and reliance on liquid petroleum gas (LPG). The key component of this product is that it is environmentally friendly.

b. How is biofertilizer made? How is it used? Who uses it? How frequently do they have access to it? What are the benefits of using biofertilizers? How is the production of biofertilizers included in the school's curriculum?
    i. Presented by younger man (p'Tor: we should get his name)
    ii. This is an organic substance that first uses the development of micro-organisms and then incorporates the use of vegetables, fruits or herbs to make the final desired product. The different types of biofertilizers are used on their respective plants. This liquid can be diluted with water and then sprayed on the plants as a pesticide a fertilizer. It acts as a hormone and enhances the performance of the plant.
c. How is wood vinegar made? How is it used? Who uses it? How frequently do they have access to it? What are the benefits of using wood vinegar? How is the production of wood vinegar included in the school's curriculum?
    i. Presented by Gift Thanawan
    ii. This project started so that the by-product could be used as an alternative for harmful chemicals. Farmers can even implement this project on their own. There are over 200 chemicals in the liquid that is produced in wood vinegar. Its three main uses are for pesticides, disinfection and to kill weeds. Wood vinegar must also be diluted prior to use. Different ratios of diluted products allow for different uses of the product. Teachers and students at the Na Yao schools perform these projects and occasionally the farmers can benefit from it. They reproduce the wood vinegar approximately every 3 months and save it during the mean time. The most important step of this process is knowing when to collect the raw wood vinegar. The quality of the raw wood vinegar depends on the procedure that is followed and how well the liquid is made.

15. What aspects of each project are most appealing to the mission of the Office of H.R.H.?
    a. Self-reliance is a key component of each project. The media should focus on the procedure and the benefits of the projects in order to promote this idea.
16. How have these projects affected the standard of living in Na Yao?
    a. The standard of living in the Na Yao schools has improved because of the sustainable development projects. For example, the students now receive food

while at school instead of going home to find food. These agricultural benefits have improved the health habits of the village. The Office does not have much information on if or how technology has transferred from schools to villagers. Try implementation in locations that the materials and procedure would be easily transferrable. In prior cases, such as the biofertilizers, countries such as Laos have implemented the projects after visiting Na Yao. However, sometimes when projects are transferred, certain parts of the procedure are implemented poorly and need to be corrected by the Office.

17. Are the visitors interested in learning about sustainable development prior to their trip to Na Yao?
    a. The visitors typically have minimal information on the Princess's projects and invited to see the details and techniques used in Na Yao, but they are usually still pretty new to the idea of sustainable development. They have some slight interest because Her Royal Highness shared it with them. Typically, the educators are especially interested if they are looking for an interactive education or if they are looking at making a sustainable development policy. The goal of these projects is to inspire self-reliance and environmental awareness amongst the children.

Appendix D

Questionnaire and results from the student dissemination questionnaire. The questions are provided in Thai, with their English translation below. The sections written in italics are the additional clarifications that the Thai group members provided to the subjects while giving the questionnaire.

แบบสอบถามนักเรียนเกี่ยวกับความรู้ความเข้าใจใน

โครงการพระราชดำริสมเด็จพระเทพรัตนราชสุดาฯ สยามบรมราชกุมารี

Student Questionnaire about the H.R.H Princess's Projects

1.ชื่อ-นามสกุล(ชั้นปี/อายุ/เพศ)

Name (Grade/Age/Sex)

- 43 students surveyed in Grade 12 at the Na Yao Secondary School: 18 years old. 63% Male, 37% Female
- 15 students surveyed in Grade 6 at the Na Isarn School: 12 years old. 47% Male, 53% Female

2. คุณมีความสนใจในโครงการของโรงเรียนบ้างหรือไม่

Are the projects at this school interesting to you?

Are the projects at this school, like raising pigs in mud holes and biofertilizers, interesting to you? Please also write down the reason for your interest.

Responses:

a. It useful for themselves and their family. (36 people)
b. It helps to save their money. (6 people)
c. Learning how to raising chicken in a correct method. (5 people)
d. It teaches how to live with sustainable life and sustainable economics. (4 people)

3. คุณมีส่วนร่วมกับโครงการใดบ้างที่โรงเรียนได้จัดทำขึ้นและอย่างไร

Which of the projects have you been involved in?

Which projects in this school have you been actually involved in? For example, watering the plants and raising chickens.

Responses:

a. Raising chicken 50/58 students
b. Raising fish 42/58 students
c. Farming plants 39/58 students
d. Rice farming 23/58 students
e. Raising frog 20/58 students
f. Biogas 13/58 students
g. Wood vinegar 12/58 students

4. คุณคิดว่าคุณมีความเข้าใจมากน้อยเพียงใดเกี่ยวกับตัวโครงการเหล่านี้ (โปรดให้คะแนน)

How well do you understand these projects? (Circle one)

1	2	3	4	5	6	7	8	9	10
Understand Poorly ไม่เข้าใจ									Understand Perfectly เข้าใจมากที่สุด

When the teacher teaches you about these projects, how much do you think you understand it? If you strongly understand everything the teacher said as well as how to do those projects, circle 10. But if you do not think that you have learned anything or do not understand anything about the project or just following the teacher's instruction, circle 1. If you partly understand the projects then circle 5.

Responses:

5/10 12/58 students
6/10 8/58 students
7/10 8/58 students
8/10 9/58 students
9/10 7/58 students
10/10 13/58 students

5.คุณเคยได้พูดคุยเกี่ยวกับโครงการเหล่านี้กับคนอื่นๆบ้างหรือไม่

Have you ever spoken with anyone outside of school about the sustainable development projects?

Have you ever spoken to anyone like your parents, neighbors, or visitors, anybody that does not involved in the school, about these projects you did at school?

Responses:

42/58 of students have shared the knowledge about H.R.H. Princess's Projects with..

a. Parents and their family 35 students
b. School's visitors 3 students
c. Villagers 3 students
d. Government staffs 1 student

6. คุณเคยพบเห็นการนำความรู้ที่ได้จากโครงการเหล่านี้ไปประยุกต์ใช้ในหมู่บ้านหรือไม่

Do you know of anyone using the same procedures of these projects in the village?
Have you ever see anyone like your neighbor or any villagers in this village doing the schools' projects with the same procedures at their houses?

Responses:

44/58 of students have seen someone using the same procedures of H.R.H. Princess's Projects in the village.

a. Parents and their family 20 students
b. Neighborhood 11 students
c. Villagers 8 students
d. Government staffs 5 students

7. ประโยชน์ที่คุณได้รับจากโครงการเหล่านี้มีอะไรบ้าง

What do you think is the benefit from these projects?
For example, minimizes the family's expense, learn more about self-reliance, and self-development.

Responses:

58/58 students said that these H.R.H. Princess's Projects in school gave them benefits.

a. Self-development in both their thinking process and studies. (13 people)
b. They can use this knowledge for their future career. (5 people)
c. They can apply similar methods at home. (4 people)

d. These projects reduce family expenses and increase family income. (12 people)
e. They can plant their own healthy vegetables now. (2 people)
f. They could make use of the newfound free time. (5 people)
g. It can be used to enhance the product. (1 people)
h. They have further studied sustainable development. (5 people)
i. They received positive experiences. (1 people)
j. They got exercise during these projects. (2 people)
k. They learned the theories of agriculture and its practices. (21 people)

8. คุณมีความคิดเห็นเพิ่มเติมใดๆเกี่ยวกับโครงการต่างๆหรือไม่

Do you have any additional opinions about these projects?

Responses:

a. There should be an expert instructor of each project to provide knowledge for the villagers.
b. These projects provided them more knowledge.
c. The Neem plant also repels pests around the vegetable farm.
d. Every project is useful and should continue.
e. The school should have more varieties of biofertilizers.
f. The chicken house should be on the fish pond in order to use the chicken manure for fish food.
g. The area around pond could be used to plant various vegetables.
h. The school should add new projects such as raising fish in the rice field and raising crickets.
i. In summer, we should set on the roof of chicken house in order to decrease the temperature.
j. The variety of fish, frog, and vegetable is needed.
k. In vegetable plant, we should set the springer.
l. The equipment of each project should have enough for using.
m. These projects teach responsibility and timing.

Appendix E

Interpretation of the interviews with Mr. Apakorn Buthchantha and his father Mr. Liem Buthchantha that were completed by the project team on January 29, 2011.

Interview with the son: Mr. Apakorn Buthchantha

Background

Mr. Apakorn was born in 1984 in Burirum, Thailand. In 1987, he moved to Na Isarn due to his family's debt and has living there ever since. Mr. Apakorn's father used to own a sugarcane and cassava farm, but he had to sell it due to his debt. The money that the family received from selling the farm was used to buy 1,500 Baht per Rai of land in Na Isarn, which was still a preserved forest at the time. In Na Isarn, he started farming corns instead of cassava. Unfortunately, this did not bring the family out of debt, because the farming was ineffective. The plants required too many chemical fertilizers, and overproduction did not produce enough products to cover the costs. In addition, upon harvesting the corn, the family had to travel 30 km to Khao Chakan in order to sell their crop.

In 1996, Mr. Liem had the opportunity to attend a seminar held by the government at Sanam Chaikate in the Cha Cheong Sao province, which inspired him to farm according to the King's sufficiency philosophy. In 1997, the family started to plant rice and trees in order to learn about the different advantages of each plant. For example, they discovered that bergamot can be used to make shampoo. The family has maintained this lifestyle ever since then. The family chose to give 37 Rai of their land to their relatives, but on their remaining 13 Rais of land, the family is growing rice and local trees, maintaining a pond and living in their home. The primary focus of their farm is to develop natural products from the plants such as food, medicine and cosmetics and to raise fish.

Scholarship to Japan

When Mr. Apakorn was 25 years old, he received a scholarship to study in Japan from the Japanese Agricultural Exchange Council (JAEC). He travelled to Saitama, Japan and was the

leading farmer representative of a group of twenty two from Thailand. Everybody who received the scholarship had to be related to a farmer so that they had the opportunity to apply their knowledge upon return. Mr. Apakorn stayed in Japan for two weeks and then moved in with a local Japanese farming family for approximately ten months to complete his studies.

During this experience, Mr. Apakorn developed a new way of thinking about agriculture. He learned to record every single detail, such as the soil, the weather and the environmental conditions on a daily basis. While Japan does not practice the Thai King's sufficiency philosophy, they do focus on producing a lot of products and selling all of them. This is in part related to their frugal lifestyle. Some of the differences between Thai and Japanese farmers are that the Japanese farmers concentrate strongly on their work, and they pay more attention to detail.

Mr. Apakorn was very appreciative of his opportunities in Japan and was eager to bring them back to his father. Because of the education that his son received at the Na Isarn school, Mr. Liem had introduced sustainable farming on his land, and Mr. Apakorn was excited to teach his father everything that he had learned during his studies.

Interview with the father: Mr. Liem Buthchantha

It took Mr. Liem a while to become interested in agriculture and the King's philosophy. He used to harvest products from his own farm and sell them to make a profit. Eventually, Mr. Liem realized that he had been practicing a poor style of farming for more than half of his life and nothing seemed to be improving. His previous farming styles caused debt, family conflict and health problems. When Mr. Liem moved his family to Na Isan and brought his son to school every day, he started to learn about the sustainable development projects at the Na Isan Border Patrol Police School. He learned that the school's projects could be applied to his family and farm.

At first, changing his way of life was difficult. In this new way of farming, Mr. Liem planted a variety of edible vegetables, fruits and rice. He learned that even if these products were not sold, then he could use them as food for his family. Mr. Liem said that: "The products in my

farm provide profit for my family one way or another. If we sell all of our products we earn money as profit but if we do not sell as many products as we expected we still earn food as a profit." He also learned about different types of plants, herbs and trees. Now, Mr. Liem has up to 300 different types of plants on his farmed and has learned a vast amount of information about sustainable farming. According to Mr. Liem, "the trees I planted are like my investment." He believes this because there are countless uses for his plants and some of his trees can have a very high price value if they grow old enough.

Mr. Liem has the opportunity to exchange his knowledge on the four benefits of the plants, herbs and trees with teachers at the Na Isan Border Patrol Police School. The schools have eight projects and Mr. Liem has applied three of them on his farm. The first of these ideas is based on the King's philosophy that "3 different plants creates 4 different benefits." These benefits are food, fuel, shelter and the environment. They help save the natural resources in Thailand. The second idea is that by growing food for lunch, the students learn about how to apply agriculture to their lives and benefit the environment. The final idea that Mr. Liem has incorporated is the Cooperation Bank that the school has started. Mr. Liem started his own rice bank and fish bank that are based off of this idea. In addition, Mr. Liem learned to record his family's expenditures and begin to follow a budget.

After learning about sustainable living in 1996, Mr. Liem was inspired to start farming according to the King's philosophy. It also made him realize that some of his family expenses were unnecessary. Some of the unnecessary spending included the money Mr. Liem used for gambling and alcohol. The annual expenditures of Mr. Liem's family prior to implementing the King's philosophy is broken down in Table 6.

Who Used the Money	How Much Was Used	Reason for Spending Money
Mr. Liem	60,000 Baht per Year	Cigarettes, Alcohol, Gambling
2 Sons	5,000 Baht per Year	School Supplies
Wife	30,000 Baht per Year	Food, Soap, Family Necessities

Table 6: A table of Mr. Liem's annual family spending prior to implementing the King's sufficiency plan.

Mr. Liem encouraged his family to start living sustainably by reviewing their expenditures record and realizing that food expenses could be eliminated by planting rice, vegetables and fruits of their own. He started to change his lifestyle by using effective micro-organisms for his farm in a slightly altered formula from what the Na Isan Border Patrol Police School was using, despite the fact that is what inspired him. Mr. Liem uses leaves and vegetables for the preparation of the micro-organisms.

After implementing the King's philosophy at his own school, Mr. Liem tried to teach and convince his neighboring villagers to perform a similar style of farming. At first, Mr. Liem thought he would need about ten years to convince twenty five percent of the villagers to practice this farming style. However, after a year of trying to convince and broaden the villagers' thinking, Mr. Liem believed that it would take eighty years instead of ten years to convince only twenty five percent of the villagers to use sustainable development. It did not seem to be worthwhile to begin educating his neighbors since less than five percent were persuaded to follow such practices.

Mr. Liem noted that it is very difficult to change a person's way of thinking when they have always been taught to think a certain way. For the few people who did implement similar projects, they also altered them to apply to their surroundings better.

After performing these practices, Mr. Liem concluded that he gained five main understandings. First, he got a chance to learn about himself. Second, he clarified the problems with his old practices. Third, he learned more about the different types of resources and alternative energies. Fourth, he learned the advantages of planning. And finally, he discovered the benefits of managing things systematically. Mr. Liem also learned how to manage a rice system, from planting the seeds to harvesting the crop and finally to eating the final product. He learned how to manage food for his family by planting rice and vegetables and saving money on those expenses. Mr. Liem learned how to make daily products such as soap, shampoo and detergent from his plants and also created a series of health supplies from his herbs. The overall message the Mr. Liem is to spread self-reliance and take advantage of its many benefits.

Appendix F

Questionnaire and results provided during Brochure Assessment. The term NIT stands for the Na Isan Border Patrol Police School teachers. NYT stands for the Phrarachathan Na Yao Secondary School teachers. NIS and NYS stand for the students at their respective schools.

แบบสอบถามความพึงพอใจเกี่ยวกับแผ่นพับของโครงการสมเด็จพระเทพรัตนราชสุดาฯ สยามบรมราชกุมารี

Brochure Assessment Component Questionnaire

แบบสอบถามฉบับนี้ถูกจัดทำขึ้นเพื่อสำรวจความคิดเห็นเกี่ยวกับตัวอย่างแผ่นพับของโครงการสมเด็จพระเทพรัตนราชสุดาฯ สยามบรมราชกุมารีซึ่งถูกจัดทำขึ้นที่โรงเรียนมัธยมบ้านนายาวและโรงเรียนตำรวจตระเวนชายแดนบ้านนาอีสาน โปรดเลือกวงคำตอบของแบบสอบถามตามความเป็นจริงเพื่อทางผู้จัดทำจะได้นำความคิดเห็นของท่านมาใช้เพื่อปรับปรุงคุณภาพและประสิทธิภาพขององแผ่นพับ

This questionnaire will be used to improve the quality and effectiveness of informational brochures for the Na Isarn and Na Yao schools. Please help us by answering each question as honestly as you can by circling the answer that you choose. Your cooperation will ensure that the success successes of this wonderful school can be shared with visitors.

1. ชื่อ-นามสกุล (เพศ/ อายุ/ ชั้นปี)

Name (Sex/Age/Grade)

Subjects	Male (%)	Female (%)	Remarks
NIT (10 p)	60	40	
NIS (15 p)	53	47	
NYT (25 p)	44	56	
NYS (49 p)	47	53	
Total (99 p)	48	52	

2. กระบวนการผลิตน้ำส้มควันไม้มีขั้นตอนที่ยาวนานและต้องการความอดทนในการปฏิบัติงาน จริง/ไม่จริง

The production of wood vinegar is a long process that requires patience True / False

Subjects	Correct (# people)	Incorrect (# people)	Remarks
NIT (10 p)	9	0	1 of N/A
NIS (15 p)	14	1	
NYT (25 p)	23	2	
NYS (49 p)	49	0	
Total (99 p)	95	3	1 of N/A

3. ปุ๋ยชีวภาพสามารถนำไปใช้ประโยชน์ได้เลยหลังจากผ่านกระบวนการผสมและเก็บไว้นาน จริง/ไม่จริง 1 สัปดาห์

Biofertilizers are ready to use when the mixture has been sealed for True / False

a week

Subjects	Correct (# people)	Incorrect (# people)	Remarks
NIT (10 p)	40	50	10 of N/A
NIS (15 p)	47	53	
NYT (25 p)	84	16	
NYS (49 p)	63	37	
Total (99 p)	64	35	1 of N/A

4. แผ่นพับนี้ดูสะดุดตาและน่าสนใจ

This brochure grabbed my attention.

ไม่เห็นด้วยอย่างยิ่ง ไม่เห็นด้วย ไม่มีความคิดเห็น เห็นด้วย เห็นด้วยอย่างยิ่ง

Strongly Disagree Disagree No Opinion Agree Strongly Agree

Subjects	SDA (#)	DA (#)	NOP (#)	AG (#)	SAG (#)	Remarks
NIT (10 p)	0	0	0	8	2	
NIS (15 p)	1	1	1	11	1	
NYT (25 p)	0	0	0	22	3	
NYS (49 p)	0	0	5	42	2	
Total (99 p)	1	1	5	83	8	

5. แผ่นพับนี้มีรูปแบบที่น่าดึงดูดใจและมีการจัดวางที่ดี

This brochure has an attractive layout.

ไม่เห็นด้วยอย่างยิ่ง ไม่เห็นด้วย ไม่มีความคิดเห็น เห็นด้วย เห็นด้วยอย่างยิ่ง

Strongly Disagree Disagree No Opinion Agree Strongly Agree

Subjects	SDA (#)	DA (#)	NOP (#)	AG (#)	SAG (#)	Remarks
NIT (10 p)	0	2	0	7	1	
NIS (15 p)	0	0	1	11	3	
NYT (25 p)	0	0	1	22	1	1 of N/A
NYS (49 p)	0	1	5	43	0	
Total (99 p)	0	3	7	84	5	1 of N/A

6. ตัวอักษรในแผ่นพับนี้มีขนาดที่เหมาะสมและอ่านง่าย

The font on this brochure is easy to read.

ไม่เห็นด้วยอย่างยิ่ง ไม่เห็นด้วย ไม่มีความคิดเห็น เห็นด้วย เห็นด้วยอย่างยิ่ง

Strongly Disagree Disagree No Opinion Agree Strongly Agree

Subjects	SDA (#)	DA (#)	NOP (#)	AG (#)	SAG (#)	Remarks
NIT (10 p)	0	2	0	6	2	
NIS (15 p)	0	1	1	10	3	
NYT (25 p)	0	4	0	20	1	
NYS (49 p)	0	10	3	34	2	
Total (99 p)	0	17	4	70	8	

7. เนื้อหาในแผ่นพับนั้นกระชับและเข้าใจง่าย

This information in this brochure is easy to understand.

ไม่เห็นด้วยอย่างยิ่ง ไม่เห็นด้วย ไม่มีความคิดเห็น เห็นด้วย เห็นด้วยอย่างยิ่ง

Strongly Disagree Disagree No Opinion Agree Strongly Agree

Subjects	SDA (#)	DA (#)	NOP (#)	AG (#)	SAG (#)	Remarks
NIT (10 p)	0	0	0	9	1	
NIS (15 p)	0	0	0	12	3	
NYT (25 p)	0	0	2	21	2	
NYS (49 p)	0	1	3	38	7	
Total (99 p)	0	1	5	80	13	

8. เนื้อหาและข้อมูลในแผ่นพับนี้สร้างแรงบันดาลใจให้ฉันอยากใช้ชีวิตอยู่อย่างพอเพียงและยั่งยืน

The information in this brochure inspires me to start living in a more sustainable manner.

ไม่เห็นด้วยอย่างยิ่ง ไม่เห็นด้วย ไม่มีความคิดเห็น เห็นด้วย เห็นด้วยอย่างยิ่ง

Strongly Disagree Disagree No Opinion Agree Strongly Agree

Subjects	**SDA (#)**	**DA (#)**	**NOP (#)**	**AG (#)**	**SAG (#)**	**Remarks**
NIT (10 p)	0	1	0	6	3	
NIS (15 p)	0	1	0	9	5	
NYT (25 p)	0	0	4	14	7	
NYS (49 p)	1	0	2	36	10	
Total (99 p)	1	2	6	65	25	

9. Additional Comments?
    1. *The content and picture should be related.*
    2. *The brochures need a common theme amongst them.*
    3. *The font of the Thai characters is too small.*
    4. *The Thai brochures need more attention to phrasing.*
    5. *For some areas, the color of the text and the background is too similar.*

Appendix G

The video scripts that the project team wrote and used to make the educational videos on wood vinegar, biofertilizers and biogas. They include the shot that was used and the audio that was recorded, in both Thai and in English.

Wood Vinegar Video Script

Film Shot	English Audio	Thai Audio
Pan shot of Field:	Agriculture is the lifeblood of many rural communities. Strong agriculture provides villages with both sustenance and a source of income	เกษตรกรรมเปรียบดั่งเลือดที่หล่อเลี้ยงชุมชนในชนบท รากฐานที่มั่นคงทางเกษตรกรรมนั้นสามารถช่วยให้ชุมชนพึ่งพาตนเอง และมีรายได้มากเพียงพอในการดำรงชีวิต
Still shot of Moldy leaves and Zoom out shot of ants:	Yet there are many obstacles that must be overcome for this to be possible. Plant fungi must be prevented, weeds must be cleared, and harmful pests must be killed or driven off. Traditionally, these issues have been solved by the use of chemical pesticides and fungicides.	การทำเกษตรกรรมให้มีประสิทธิภาพนั้นเป็นเรื่องยากและมีอุปสรรคมากมาย ไม่ว่าจะเป็น การยับยั้งการเกิดเชื้อราบนต้นไม้ การกำจัดวัชพืช หรือการปราบศัตรูพืชที่อันตราย แต่เดิมนั้นอุปสรรคเหล่านี้ถูกจัดการโดยการใช้สารเคมีชนิดต่างๆ
Pesticide Zoom Out:	However, chemical pesticides are both costly and harmful to the environment.	ก็ตาม สารเคมีที่นิยมใช้มักมีราคาแพงและเป็นอันตรายต่อสิ่งแวดล้อม
Wood Vinegar Pan Shot:	Wood vinegar is a low-cost and low-tech alternative to hazardous chemical substances. This material can substitute for many chemical mixtures, acting as an excellent pesticide, weed killer, and fungicidal agent.	น้ำส้มควันไม้เป็นอีกทางเลือกหนึ่งที่สามารถทดแทนการใช้สารเคมีอันตรายเหล่านั้นได้ โดยน้ำส้มควันไม้สามารถ Top of Form น้ำส้มควันไม้สามารถผลิตจากวัสดุในชีวิตประจำวันทั่วไป ซึ่งแม้หมู่บ้านอันห่างไกลก็สามารถผลิตได้

		อีกทั้ง เป็นการสนับสนุนการเกษตรแบบพึ่งพาตนเอง
Spraying Shot:	In addition, Wood Vinegar can be manufactured using everyday materials, enabling even the most remote villages to become self-sufficient in their crop protection.	โดยน้ำส้มควันไม้สามารถ Top of Form น้ำส้มควันไม้สามารถผลิตจากวัสดุในชีวิตประจำวันทั่วไป ซึ่งแม้หมู่บ้านอันห่างไกลก็สามารถผลิตได้ อีกทั้ง เป็นการสนับสนุนการเกษตรแบบพึ่งพาตนเอง
Smiling Kids Chopping:	With crops protected by Wood Vinegar, villages can afford to thrive while ensuring their children inherit healthy land. Everyone benefits from adopting this sustainable alternative to hazardous pesticides and fungicides.	การใช้น้ำส้มควันไม้แทนสารเคมีเพื่อดูแลผลผลิตทางการเกษตร ทำให้แปลงเกษตรปลอดจากสารพิษและมีความอุดมสมบูรณ์ในระยะยาว เพื่อให้คนในชุมชนและลูกหลานของพวกเขามีการเกษตรอย่างยั่งยืนในอนาคต
Pan shot of Kiln:	To begin producing wood-vinegar, a kiln must first be constructed. This kiln will hold wood while it is fired and smoked.	การผลิตน้ำส้มควันไม้นั้นจำเป็นอย่างยิ่งที่จะต้องสร้างเตาเผา
CGI1:	To construct a kiln, first cut the top off of a 200L metal barrel.	เริ่มจาก ตัดฝาด้านบนของถังขนาดบรรจุสองร้อยลิตรออกเพื่อใช้ทำเป็นฝาเตา
CGI2:	Next, remove a 20cm square from the lid of the barrel. This is where heat will enter the kiln.	จากนั้น ทำช่องสี่เหลี่ยมขนาด20x20 ซม.บนฝาเตา ซึ่งช่องนี้มีไว้สำหรับให้ความร้อนเข้าไปในเตาเผา
CGI3:	Then cut a 10cm diameter hole in the bottom of the barrel.	เจาะช่องเป็นรูปวงกลมขนาด10 ซม. ที่บริเวณส่วนล่างของก้นถัง
CGI4:	Attach an asbestos joint and pipe to this hole. This is where the smoke from the kiln will escape.	ต่อท่อโค้งงอเข้ากับส่วนล่างของก้นถัง ซึ่งปลายของท่อโค้งงอนี้จะทำหน้าที่เป็นปล่องควัน
CGI5:	Then enclose the barrel and bury it in dirt, leaving the asbestos chute exposed at the top. Tilt the barrel up by propping a 10-12 cm brick under the	จากนั้นยึดตัวถังด้วยการใช้ดินกลบ โดยวางถังในลักษณะลาดเอียงด้วยการใช้อิฐ

	front of it.	ซึ่งจะทำให้ด้านหน้าของถังถูกยกสูงขึ้นประมาณ 10 – 12 ซม. และต้องแน่ใจว่าปล่องควันอยู่พ้นเหนือดินที่กลบ
Review1:	Let us review the steps involved in constructing a wood vinegar kiln.	ทบทวนขั้นตอนการสร้างเตาเผากันอีกครั้ง
Review2:	First, create the main kiln chamber from a 200L barrel. Remember to cut a 10cm hole in the bottom.	ขั้นแรก สร้างตัวเตาเผาจากถังขนาดบรรจุ 200L อย่าลืมที่จะตัดช่องขนาด10ซม. ที่ก้นถัง
Review3:	Second, create the kiln lid by cutting a 20cm square out of the 200L barrel lid	ขั้นที่สอง สร้างฝาเตาโดยตัดช่องขนาด20x20ซม. ที่ฝาด้านบน
Review4:	Third, attach an Asbestos joint and pipe to the 10cm hole in the barrel	ขั้นที่สาม ต่อท่อโค้งงอเข้ากับช่องขนาด10cm ที่ก้นถัง
Review5:	Finally, bury the assembled kiln. Be sure to leave the chute exposed.	สุดท้าย ยึดตัวถังด้วยการใช้ดินกลบ โดยให้ปล่องควันอยู่พ้นเหนือจากดินที่กลบไว้
Production1:	With these steps completed, the production process, known as dry distillation, is now ready to begin.	หลังจากเสร็จสิ้นการสร้างเตาเผา ต่อไปจะเป็นส่วนของขั้นตอนการกลั่นแห้ง
Production2:	First the kiln must be loaded with wood. This wood can be from any type of tree.	เริ่มจาก เรียงไม้เข้าเตาเผา ซึ่งไม้ที่ใช้นั้น สามารถเป็นไม้ชนิดใดก็ได้
Production3:	To ensure proper airflow, place 3 short pieces of wood into the kiln in a perpendicular arrangement.	โดยเรียงไม้หมอน 3 ท่อนเข้าไปวางตามแนวขวางของถังก่อน เพื่อให้เกิดการไหลเวียนของอากาศภายในตัวถัง
Production4:	Place the remaining wood inside the kiln, with smaller pieces on the bottom and larger pieces on the top. Take care that no logs extend out of the body of the kiln.	เรียงไม้ที่เหลือเข้าในเตาเผา โดยเรียงไม้จากขนาดเล็กสุดไว้ด้านล่าง และขนาดใหญ่สุดไว้ด้านบน ซึ่งความยาวของไม้ที่เรียงเข้าไปไม่ควรยาวเกินกว่าตัวถัง
Production5:	After putting the lid in its place, apply clay around the edges to create an	จากนั้นทำการปิดฝาเตา โดยใช้ดินเหนียวเป็นตัวเชื่อมรอย

	airtight seal. This clay should be mixed with rice barn to increase its strength and resistance to heat.	ดินเหนียวที่ใช้นั้นจะต้องเป็นดินเหนียวผสมแกลบ เพื่อเพิ่มความคงทนต่อความร้อนและความแข็งแรง
Production6:	Next, create a small fireplace by placing 4 bricks in the following pattern.	นำอิฐสี่ก้อนมาเรียงเพื่อใช้เป็นที่ก่อไฟ ซึ่งเป็นช่องทางให้ความร้อนเข้าไปในเตาเผา
Production7:	These bricks must be also sealed with clay.	อิฐหล่านี้จะถูกเชื่อมและอุดรูด้วยดินเหนียว เพื่อไม่ให้มีช่องระบายอากาศ
Production8:	A small fire needs to be started outside of the kiln in order to begin the production process. To be certain that charcoal forms, make sure the wood inside the kiln is not in direct contact with the flames.	จุดไฟบริเวณด้านหน้าที่ก่อไฟเพื่อที่จะเริ่มกระบวนการผลิตน้ำส้มควันไม้ โดยต้องระวังไม่ให้ไม้ภายในเตาถูกเผาโดยตรงจากไฟ
Production9:	This fire must be kept going throughout the production process as it is the driving force behind the production of wood vinegar and charcoal.	ระวังไม่ให้ไฟดับขณะอยู่ในกระบวนการผลิตน้ำส้มควันไม้ เพราะไฟนี้เป็นปัจจัยสำคัญในการผลิตน้ำส้มควันไม้
Production10:	After approximately 2 hours, thick white smoke should begin to rise out of the asbestos chute. This signals that the wood vinegar is ready to be collected.	หลังจากผ่านไปประมาณ2ชม. จะมีควันหนาสีขาวปรากฏออกมาจากปล่องควัน ซึ่งแสดงว่าน้ำส้มควันไม้นั้นพร้อมที่จะถูกเก็บแล้ว
Review	Let us review again	มาทบทวนขั้นตอนการผลิตน้ำส้มควันไม้กันอีกครั้ง
Review2-1:	First, load the kiln with wood. Remember to lay 3 small sticks across the bottom to promote air flow.	ขั้นที่หนึ่ง เรียงไม้เข้าเตาเผา โดยที่จะต้องเรียงไม้หมอน3ท่อนตามแนวขวางก่อน
Review2-2:	Second, place the lid on the kiln and seal it with clay. The seal must be completely airtight.	ขั้นที่สอง ปิดฝาเตาและเชื่อมรอยต่อด้วยดินเหนียวให้สนิท
Review2-3:	Third, create a small fireplace by laying clay-sealed bricks in front of the kiln.	ขั้นที่สาม นำอิฐมาเรียงสำหรับเป็นที่ก่อไฟ ใช้ดินเหนียวเชื่อมระหว่างอิฐและอุดรูไม่ให้มีช่องระบายอากาศ

Review2-4:	Fourth, light and maintain a small fire in front of the brick fireplace.	ขั้นที่สี่ จุดไฟบริเวณด้านหน้าที่ก่อไฟ
Review2-5:	Finally, when thick white smoke begins to continuously rise from the asbestos chute, the collection process is ready to begin.	ขั้นสุดท้าย หลังจากปรากฏควันหนาสีขาวต่อเนื่องออกมาจากปล่องควัน แสดงว่าน้ำส้มควันไม้พร้อมที่จะถูกเก็บแล้ว
Collection1:	A bamboo pipe can now be attached to the asbestos chute. This bamboo pipe must be hollowed out and one end of it should be cut on an angle. A notch should also be cut near the base of it, so that the condensate can drip out. Seal the connection between the bamboo pipe and the asbestos chute with clay and wrap it in a wet towel.	นำท่อไม้ไผ่ที่ถูกบากรูไว้แล้วมาเชื่อมกับปลายปล่องควันโดยใช้ดินเหนียว แล้วจึงนำผ้าที่เปียกพอหมาดมาห่อที่ดินเหนียวอีกชั้นเพื่อป้องการแตกของดินเหนียวเมื่อได้รับความร้อน
Collection2:	Wrap more wet towels along the length of bamboo pipe, taking care to leave the notch unobstructed. These towels cool the smoke and allow it to condense. If done correctly, thick smoke should begin to pour out of the notch in the pipe.	แล้วจึงนำผ้าเปียกหมาดมาพันตามความยาวของท่อไม้ไผ่ตั้งแต่บริเวณเหนือรอยบากขึ้นไป ซึ่งผ้านี้จะช่วยทำให้ควันที่อยู่ภายในท่อไม้ไผ่เย็นตัวและกลั่นเป็นหยดน้ำ
Collection3:	Hang a bottle below the notch to collect the wood vinegar as it drips out.	นำขวดมาแขวนไว้ใต้รูที่บากไว้สำหรับใช้เก็บน้ำส้มควันไม้
Collection4:	Soon, the condensate should begin to drip into the bottle. Maintain the fire and moisture of the towels	หลังจากนั้นไม่นาน น้ำส้มควันไม้ก็จะเริ่มกลั่นตัวและหยดลงมาในขวด
Collection5:	Wait for several hours while the wood vinegar collects.	ซึ่งขั้นตอนการเก็บน้ำส้มควันไม้ต้องใช้เวลาหลายชั่วโมง
Collection6:	When the condensate becomes black, detach the full bottle from the bamboo pipe.	เมื่อสีของน้ำส้มควันไม้ที่หยดออกมาเริ่มกลายเป็นสีดำ จึงทำการหยุดเก็บน้ำส้มควันไม้แล้วนำขวดออก
Collection7:	Pour the collected liquid into a larger	เทของเหลวที่ได้สู่ภาชนะบรรจุ

	bottle for storage. At this point the mixture should be light brown.	ซึ่งของเหลวที่ได้จะมีสีน้ำตาล
Collection8:	Next, detach the bamboo pipe and wait until the smoke gets thinner. Then, seal the brick entrance of the kiln and the asbestos chute so that it is completely airtight. This allows useful charcoal to be formed.	จากนั้นนำท่อไม้ไผ่ออกรอจนกว่าควันจะจางลง จึงทำการปิดด้านหน้าเตาและปล่องควันด้วยด้วยอิฐและดินเหนียวให้สนิท เพื่อที่จะทำให้ไม้ภายในเตากลายเป็นถ่าน
Collection9:	The following morning, return and unseal the kiln, removing the bricks and clay.	วันถัดไป แกะดินเหนียวและอิฐออกเพื่อเปิดเตา
Collection10:	If the process was done correctly, the wood in the kiln should now be charcoal.	ถ้ากระบวนนี้เป็นไปอย่างถูกต้อง จะปรากฏถ่านบริสุทธิ์ภายในเตา
Review3-1:	Let us review the collection of Wood Vinegar	มาทบทวนขั้นตอนการเก็บน้ำส้มควันไม้อีกครั้ง
Review3-2:	First, attach a long bamboo pipe to the asbestos chute. This connection must then be sealed with clay.	เริ่มจาก เชื่อมท่อไม้ไผ่ที่บากรูไว้แล้วกับปลายปล่องควันด้วยดินเหนียว
Review3-3:	Second, wrap wet towels around the bamboo pipe. Be sure not to cover the notch in the pipe.	ขั้นที่สอง นำผ้าเปียกหมาด มาพันท่อไม้ไผ่
Review3-4:	Third, hang a bottle under the notch in the bamboo pipe and wait as the condensate collects. Maintain the fire and the moisture of the towels.	ขั้นที่สาม แขวนขวดไว้ใต้รอยบากเพื่อเก็บน้ำส้มควันไม้
Review 3-5	Finally, once the drips of condensate become black, detach the bamboo pipe and seal the kiln. This allows useful charcoal to form.	เมื่อน้ำส้มควันไม้ที่หยดออกมาเริ่มเป็นสีดำ นำท่อไม้ไผ่ออกและปิดเตาให้สนิท เพื่อให้ไม้ภายในกลายเป็นถ่าน
Afterward1:	Now, collect the charcoal from the kiln. It is ready to be used.	ถ่านที่จากการผลิตนั้นสามารถนำไปใช้เป็นเชื้อเพลิงได้ทันที
Afterward2:	The wood vinegar condensate must be left alone for 90 days. In the bottle, it will separate into three layers: A clear oily top layer, a brownish middle layer, and a dark tar bottom layer. The middle layer is the usable wood	น้ำส้มควันไม้ที่เก็บได้ จะต้องตั้งทิ้งไว้90วัน เพื่อให้แยกเป็น3ชั้น โดยชั้นบนสุดจะมีลักษณะเป็นน้ำมันใส ส่วนชั้นที่สองจะมีสีน้ำตาลอ่อนซึ่งเป็นส่วนของน้ำส้มควันไม้ที่จะนำไปใช้ และส่วนที่สามจะมีสีน้ำตาลเข้มซึ่งเป็นส่วนของน้ำมันดิน

	vinegar. Use a syringe to extract this layer from the bottle.	
Afterward3:	To use wood vinegar, it must be mixed with water. The ratio of wood vinegar to water depends on the desired application: For use as a pesticide, combine 1 part wood vinegar with 20 parts water.	การนำน้ำส้มควันไม้ไปใช้ประโยชน์ จะต้องมีการผสมสัดส่วนตามวัตถุประสงค์การใช้งาน เช่น ผสมน้ำส้มควันไม้1ส่วนกับน้ำ20ส่วน สำหรับเป็นยากำจัดแมลง
Afterward4:	For use as weed killer, combine 1 part wood vinegar with 50 parts water.	ผสมน้ำส้มควันไม้1ส่วนกับน้ำ50ส่วน สำหรับยากำจัดวัชพืช
Afterward5:	For use as an anti-fungal agent, combine 1 part wood vinegar with 100 parts water.	ผสมน้ำส้มควันไม้1ส่วนกับน้ำ100ส่วน สำหรับยาฆ่าเชื้อรา
Afterward6:	For use as a pest repellent, anti-mold agent, and plant growth accelerant, combine 1 part wood vinegar with 200 parts water.	ผสมน้ำส้มควันไม้1ส่วนกับน้ำ200ส่วน สำหรับยาป้องกันศัตรูพืช รา และ เร่งการเจริญเติบโตของพืช
Afterward7:	For use as an anti-plant lice spray, combine 1 part wood vinegar with 400 parts water.	ผสมน้ำส้มควันไม้1ส่วนกับน้ำ400ส่วน สำหรับยาป้องกันเพลี้ย
Afterward8:	For use as a growth enhancer in fruit plants, combine 1 part wood vinegar with 500 parts water.	ผสมน้ำส้มควันไม้1ส่วนกับน้ำ500ส่วน สำหรับยาเร่งผลผลิตของไม้ผล
Closing:	Choosing to replace harmful chemical pesticides and fungicides with wood vinegar benefits everyone. The environment benefits from the removal of unnatural chemicals. The farmer benefits from the low cost and self-reliability of wood vinegar. The consumer benefits from a product that is safer and healthier. So why not switch to wood vinegar today? The benefits of this low-cost natural solution await.	การนำน้ำส้มควันไม้ไปใช้แทนยากำจัดแมลงและยาฆ่าเชื้อรานั้น มีประโยชน์หลายด้าน อาทิเช่น ประโยชน์ต่อสิ่งแวดล้อม ในการทำให้สิ่งแวดล้อมสะอาดและปราศจากสารเคมีที่เป็นพิษ สำหรับประโยชน์ต่อเกษตรกร โครงการน้ำส้มควันไม้ได้ทำให้พวกเขาได้เรียนรู้เกี่ยวกับการพึ่งพาตนเอง อีกทั้งโครงการน้ำส้มควันไม้ยังช่วยให้ผู้บริโภคได้รับประทานผลผลิตที่ปลอดสารพิษ ด้วยเหตุนี้ เราจึงไม่ควรรอช้า ที่จะนำโครงการน้ำส้มควันไม้ไปปฏิบัติ เพื่อให้ได้มาซึ่ง จึงมีความน่าสนใจทั้งต้นทุนต่ำและเป็นมิตรต่อสิ่งแวดล้อม

Biofertilizers Video Script

Time	Video	English	Thai
8 seconds	Timelapsed shot of a sunset over Na Yao		
6 seconds	Pan shot of the Na Yao school		
6 seconds	Shot of children working on a project		
6 seconds	Shot of something being processed		
4 seconds	Shot of instructor teaching something in woods		
5 seconds	Still shot of banner reading "The Office of Her Royal Highness Presents"		
5 seconds	Still shot of "Bio-fertilizer" over backdrop (blurred image of kiln)		
8 seconds	Pan Shot: Vegetables in a farm	Modern agricultural practices often call for the use of fertilizers to enhance soil quality and crop yield.	การทำเกษตรกรรมใน ปัจจุบันมักพึ่งพาการใช้ปุ๋ยในการเพิ่มคุณ ภาพ ของดินและเพิ่มปริมาณผลผลิต
6 seconds 6 seconds	Shot of bags of chemical fertilizer. Shot of pollution.	Traditionally, chemical fertilizers which are heavy in nitrogen, have been used for this purpose. However, these can lead to a wide variety of ecological and agricultural problems, such as groundwater pollution and vulnerability to certain pests.	ในอดีตปุ๋ยที่ใช้จะเป็น ปุ๋ยเคมีที่มีธาตุ ไนโตรเจนสูงซึ่ง สามารถทำให้ได้ ผลผลิตจำนวนมาก อย่างไรก็ตามปุ๋ยเคมี เหล่านี้ล้วนทำให้เกิด ผลกระทบทางด้าน

			ระบบนิเวศน์และ ภาคเกษตรกรรม อาทิเช่น การปนเปื้อนสารเคมีในน้ำบาดาล และการที่พืชผักมีความต้านทานต่อศัตรูพืชลดลง
10 seconds 5 seconds	Pan shot of healthy-looking plants Shot of villagers	Bio-fertilizers are an eco-friendly substitute for these harmful inorganic fertilizers. Not only do these materials cause no environmental damage, but they aid in plant growth in ways that inorganic fertilizers cannot. Furthermore, bio-fertilizers can be produced from easily accessible organic materials so even the most remote villages can use them to be more agriculturally self-reliant.	ปุ๋ยชีวภาพเป็นปุ๋ยที่เป็นมิตรต่อสิ่งแวดล้อมและสามารถทดแทนการใช้ปุ๋ยเคมีที่อันตรายได้ นอกจากนั้นปุ๋ยชีวภาพยังมีประสิทธิภาพเหนือปุ๋ยเคมีอันตรายในการช่วยปรับสภาพแวดล้อมทางธรรมชาติกลับคืนสู่ความอุดมสมบูรณ์อีกครั้ง อีกทั้งวัตถุดิบที่ใช้ในการผลิตปุ๋ยชีวภาพนั้นสามารถหาได้ง่ายซึ่งทำให้โครงการปุ๋ยชีวภาพนี้ช่วยส่งเสริมการทำเกษตรกรรมแบบพึ่งพาตนเอง
15 seconds	Show shot of each ingredient	In this particular bio-fertilizer rice husk, rice barn, bamboo leaves, soil, and water are used.	ขั้นตอนในกระบวนการผลิตปุ๋ยชีวภาพนั้น เริ่มจากการเตรียมส่วนผสมต่างๆประกอบไปด้วย แกลบ รำข้าว ใบไผ่ น้ำ และดิน
10 seconds 5 seconds	Shot showing Thai students digging. Cut to close up of student collecting soil.	First, soil containing the useful micro-organisms must be gathered. These micro-organisms increase microbial diversity in the soil and plants restoring nutrients which significantly improves soil quality and plant growth (Hagi 1994). To gather the micro-organisms dig a 5 cm hole in an undisturbed patch of ground next to a tree. Soil should be collected from the bottom of this hole.	โดยดินที่ใช้ต้องเป็นดินที่มีเชื้อจุลินทรีย์ที่เป็นประโยชน์ซึ่งหาได้จากพื้นที่ที่ไม่เคยถูกรบกวนจากการทำเกษตรกรรมของมนุษย์หรือการทำกิจกรรมอื่นๆจุลินทรีย์ที่เป็นประโยชน์เหล่านี้จะช่วยเพิ่มความหลากหลายทางชีวภาพของจุลินทรีย์ในดินและพืชซึ่งถือเป็นการเพิ่มสารอาหารที่จำเป็นต่อคุณภาพของดินและการเจริญเติบโตของพืช
15 seconds	Show shot of each ingredient on scale.	Carefully weigh 1 kg of bamboo leaves, 5 kg of rice husk, 2 kg of rice barn, and 1 kg of the soil that was just	ชั่งส่วนผสมต่างๆตามปริมาณดังต่อไปนี้ ใบไผ่ 1 กิโลกรัม แกลบ 5 กิโลกรัม รำข้าว 2 กิโลกรัม และดินที่มีจุลินทรีย์ที่เป็นประโยชน์ 1

5 seconds	Cut to show ingredients on the ground ready to be mixed.	collected.	กิโลกรัม
8 seconds	Show mixing of ingredients with hoe.	These ingredients should be combined thoroughly; making sure the mixture is consistent and to allow for the micro-organisms to cover as much area as possible.	ส่วนผสมต่างๆจะถูกคลุกเคล้าให้เข้ากันเ พื่อทำให้เกิดการกระจายตัวของจุลินทรีย์
6 seconds	Show water being poured onto mixture and a hand checking for moisture	While mixing, pour some water over the blend to add moisture.	ขณะคลุกส่วนผสมให้เติมน้ำลงไปเพื่อเพิ่ มความชุ่มชื้นให้กับส่วนผสมและทำให้ ส่วนผสมเข้ากันมากขึ้น
8 seconds 4 seconds	Show hand spreading mixture in bucket and forming depression Shot of depression	When the mixture is both consistent and moist, transfer it into a 50cm diameter bucket. Spread the blend evenly on the bottom and create a depression in the center. This provides ventilation and prevents the beneficial micro-organisms from overheating.	เมื่อส่วนผสมเข้ากันและมีความชุ่มชื้นเพี ยงพอ ให้นำส่วนผสมนี้เกลี่ยลงในถังที่มีเส้นผ่า นศูนย์กลางขนาด 50เซนติเมตร โดยเว้นช่องตรงกลางไว้เพื่อให้เป็นรูระบ ายอากาศและความร้อนสำหรับป้องกันก ารตายของเชื้อจุลินทรีย์อันเกิดจากอุณห ภูมิที่สูงขึ้น
5 seconds 6 seconds	Cut to student putting cover on bucket and moving it from a sunny to a shady area Cut to student coming back and mixing again	Cover the bucket and let it sit in the shade. Mix the contents every 4 days, spreading it out evenly once again and forming the depression. This process should be repeated for a month.	นำฝามาครอบถังแล้วจึงย้ายไปไว้ในที่ร่ม คลุกส่วนผสมทุกๆสี่วันและทำให้มีรูระ บายอากาศเหมือนเดิม ทำเช่นนี้ติดต่อกันเป็นเวลาหนึ่งเดือน
8 seconds	Show time lapse (of formation if possible)	The mixture is ready to be used when a coat of white fibers is formed.	เมื่อปรากฏใยสีขาว ปกคลุมส่วนผสมแสดงว่าส่วนผสมนี้พร้ อมที่จะเป็นหัวเชื้อแห้งเพื่อใช้ในขั้นตอน ต่อไป
30 seconds	Text summary of the steps on a solid	Let us review the micro-organism collection process.	มาทบทวนกระบวนการจัดเก็บจุลินทรีย์ ที่มีประโยชน์ในดินกันอีกครั้ง

	background. Background shot is of soil in a container.	First, gather the micro-organisms by collecting 1 kg of soil from a 2 inch hole near a tree. Second, mix the soil thoroughly with 1 kg of bamboo leaves, 5 kg of rice husk, and 2 kg of rice barn. Add water to moisten the material while doing this. Third, transfer the soil mixture to a 50cm diameter bucket. Make a depression in the center to allow ventilation. Fourth, cover the mixture and place it in the shade. Every four days, mix the contents, taking care to make a new depression in the center every time. After 30 days, the micro-organisms are ready to be cultivated.	ขั้นตอนแรก ขุดหลุมลึก 5 เซนติเมตรจากพื้นที่ที่ไม่เคยถูกรบกวนมาก่อนแล้วจึงเก็บดินที่มีจุลินทรีย์ที่เป็นประโยชน์ปริมาณ 1 กิโลกรัม ขั้นที่สอง นำดินที่เก็บมานั้นคลุกกับใบไผ่ 1 กิโลกรัม แกลบ 5 กิโลกรัม และรำข้าว 2 กิโลกรัม ระหว่างคลุกส่วนผสมให้เติมน้ำเพื่อเพิ่มความชุ่มชื้น ขั้นที่สาม นำส่วนผสมที่คลุกจนเข้ากันแล้วมาเกลี่ยลงในถังที่มีขนาดเส้นผ่านศูนย์กลาง50 เซนติเมตรแล้วจึงเว้นช่องตรงกลางไว้เป็นรูระบายอากาศ ขั้นที่สี่ นำฝามาครอบถังแล้วย้ายไปเก็บไว้ในที่ร่ม หมั่นคลุกส่วนผสมทุกๆ 4 วันเป็นระยะเวลาหนึ่งเดือน โดยไม่ลืมว่าจะต้องเว้นช่องสำหรับรูระบายอากาศในทุกๆครั้งที่ทำการคลุก จากนั้นจึงรอประมาณ 30 วัน ส่วนผสมที่ได้จะพร้อมนำไปใช้เป็นหัวเชื้อแห้งในขั้นตอนถัดไป
15 seconds 6	Show sample solution Cut to show	In order to process the micro-organisms, first collect the following ingredients. 0.5 kg of the dried sample 15 L of molasses 1 net bag 75 L of clean water. If molasses is not available,	ในกระบวนการทำน้ำหัวเชื้อจะต้องเตรียมส่วนผสมดังต่อไปนี้ หัวเชื้อแห้ง 0.5 กิโลกรัม กากน้ำตาล 15 ลิตร ถุงตาข่าย 1 ใบ น้ำสะอาด 75 ลิตร ในกรณีที่ไม่มีกากน้ำตาลสามารถใช้น้ำตาลปริมาณ 15 กิโลกรัมแทนได้

seconds	ready to be mixed.	15 Kg of brown sugar can be used.	
5 seconds	Shot of tying net bag.	Place 0.5 kg of the dried sample in the net bag and tie it.	นำหัวเชื้อแห้งปริมาณ 0.5 กิโลกรัมมาใส่ในถุงตาข่ายแล้วมัดปากถุงให้แน่น
8 seconds	Shot of pouring molasses	Using a beaker, measure 15 L of molasses, 1 L at a time.	จากนั้นจึงใช้ถ้วยตวงขนาด 1 ลิตรตักกากน้ำตาลเติมลงในถังบรรจุขนาด 100 ลิตรเป็นปริมาณ 15 ลิตร
5 seconds	Shot of pouring water	To quickly fill the container with water, use a 15 L watering can	แล้วจึงใช้บัวรดน้ำขนาด 15 ลิตรตักน้ำเติมลงไปในถังเป็นปริมาณ 75 ลิตร
5 seconds 5 seconds	Shot of bag being placed in the solution Shot of stirring in one direction	Next, soak the net bag in the solution. Always stir in one direction to avoid disturbing the fragile micro-organisms. It is well mixed when you notice the molasses is no longer sticky.	หลังจากนั้นนำถุงตาข่ายที่มีหัวเชื้อแห้งมาหย่อนลงในถังที่บรรจุน้ำและกากน้ำตาล จากนั้นจึงใช้ไม้กดให้ถุงตาข่ายจมและคนไปในทิศทางเดียวเพื่อป้องกันการตายของเชื้อจุลินทรีย์ คนจนกว่าน้ำและกากน้ำตาลจะกลายเป็นเนื้อเดียวกันซึ่งสังเกตได้จากการไม่มีกากน้ำตาลติดอยู่ที่ปลายไม้
6 seconds	Shot of a calendar with days flying off, and a time lapsed barrel.	Once the mixture has been stirred sufficiently, seal the barrel and let stand for 30 days without opening the lid.	เมื่อส่วนผสมถูกคนจนเป็นเนื้อกันแล้วจะนำฝามาปิดที่ถังและตั้งทิ้งไว้เป็นเวลา 30 วันโดยห้ามมิให้เปิดฝาออก
8 seconds	Shot of student opening lid cut to inside of barrel, make sure white stuff is visible	After 30 days, the solution should be fermented and a white layer should be visible.	เมื่อครบ 30 วันแล้ว จะมีคราบสีขาวปรากฏอยู่ด้านบนของส่วนผสมซึ่งแสดงให้เห็นว่าส่วนผสมนี้พร้อมที่จะนำไปใช้เป็น น้ำหัวเชื้อแล้ว
30 seconds	Text summary of the steps on a solid background. Background shot is the white layer of the solution in the barrel.	Let us review the micro-organism cultivation process. After collecting the necessary ingredients, mix the water and molasses in a 100L barrel.	มาทบทวนขั้นตอนการทำน้ำหัวเชื้อกันอีกครั้ง เริ่มจากเตรียมส่วนผสมดังต่อไปนี้ หัวเชื้อแห้ง 0.5 กิโลกรัม กากน้ำตาล 15 ลิตร ถุงตาข่าย 1 ใบ น้ำสะอาด 75 ลิตร ในกรณีที่ไม่มีกากน้ำตาลสามารถใช้น้ำตาลปริมาณ 15 กิโลกรัมแทนได้

		place the dry sample into the net bag. Then place the bag into the100L barrel. Stir the mixture in one direction. Fourth, seal the barrel and leave it for 30 days. After 30 days the micro-organisms should be cultivated and ready to be made into fertilizer.	จากนั้นนำน้ำและกากน้ำตาลมาคนให้เป็นเนื้อเดียวกันในถังบรรจุขนาด 100 ลิตร ต่อมานำหัวเชื้อแห้งปริมาณ 0.5 กิโลกรัมมาใส่ในถุงตาข่ายแล้วมัดปากถุงให้แน่น แล้วจึงนำปหย่อนลงในถัง คนไปในทิศทางเดียวกัน ปิดฝาถังและตั้งทิ้งไว้เป็นเวลา 30 วัน เมื่อครบ 30 วันแล้ว ส่วนผสมนี้พร้อมที่จะนำไปใช้เป็นน้ำหัวเชื้อสำหรับการผลิต ปุ๋ยชีวภาพ
20 seconds	Shot of student moving a bag of vegetables and chopping them in front of the rest of the ingredients	Different fertilizers can be produced for various applications depending on the ingredients used such as vegetables, fruits, herbs to produce fertilizers for different applications. In this video, the production of vegetable biofertilizers will be shown.	ปุ๋ยชีวภาพแต่ละชนิดล้วนแล้วแต่มีการนำไปใช้ที่แตกต่างกัน ซึ่งปุ๋ยแต่ละชนิดนี้สามารถเตรียมได้จากวัตถุดิบต่างๆ อาทิเช่น เศษผัก เศษผลไม้ หรือสมุนไพร โดย ณ ที่นี้จะนำเสนอการเตรียมปุ๋ยชีวภาพจากเศษผักเพื่อใช้ในการทำให้พืชผักแข็งแรง อีกทั้งช่วยให้พืชผักที่ได้มีขนาดและปริมาณตามที่ต้องการ
15 seconds	Show shot of each ingredient.	The ratio of the final mixture is 1 part micro-organism 1 part molasses 10 parts water 1/3 of the container should be filled with chopped vegetables. The exact mass of each ingredient to be used depends on the desired amount of the final product.	ในการทำปุ๋ยชีวภาพนั้นจะต้องคำนึงถึงปริมาณของปุ๋ยชีวภาพที่ต้องการแล้วจึงคำนวณเพื่อหาปริมาณของวัตถุดิบที่ต้องใช้ตามสัดส่วนที่ได้กำหนดไว้ดังต่อไปนี้ น้ำหัวเชื้อ 1 ส่วน กากน้ำตาล 1 ส่วน น้ำ 10 ส่วน และเศษผักปริมาณ 1ใน 3 ของถังที่ใช้เตรียมปุ๋ยชีวภาพ

8 seconds 5 seconds	Shot of water, molasses and micro-organism being added. Shot of mixture being stirred in one direction.	Once the ingredients have been gathered, mix the water, molasses, and the micro-organisms together, remembering to measure carefully and follow the ratios. As in the cultivation stage, stir in only one direction.	เมื่อเตรียมวัตถุดิบได้ตามปริมาณที่ต้องการแล้ว จึงเริ่มเทน้ำ กากน้ำตาลและน้ำหัวเชื้อจุลินทรีย์ลงในถังบรรจุแล้วคนไปทิศทางเดียวกันจนส่วนผสมเข้ากัน
8 seconds	Shot of students adding vegetables. Mid distance slow zoom to close-up.	Next, add the chopped material and continue to stir.	จากนั้นจึงนำเศษผักที่เตรียมไว้เทลงไปถังแล้วจึงคนต่อจนส่วนผสมเข้ากัน
6 seconds	Shot of barrel being sealed	When all of the chopped material has be added, tightly seal the barrel and let stand. This can take up to 90 days. The biofertilizers will be ready when the smell of alcohol is present, along with a white film on the surface of the mixture.	ปิดฝาถังให้สนิทแล้วตั้งทิ้งไว้เป็นเวลา 15วัน เมื่อได้กลิ่นแอลกอฮอล์และเห็นคราบสีขาวลอยอยู่บนส่วนผสมแล้ว แสดงว่าปุ๋ยชีวภาพที่หมักไว้พร้อมจะถูกนำไปใช้
30 seconds	Text summary of the steps on a solid background. Background shot is of the sealed barrel.	Let us review the bio-fertilizer production process. First gather the following ingredients: The cultivated micro-organism Molasses Water Chopped Vegetables Remember to adhere to the ratios of: 1 part micro-organism 1 part molasses 10 parts water 1/3 of the container chopped	มาทบทวนขั้นตอนการทำปุ๋ยชีวภาพกันอีกครั้ง ขั้นแรก เตรียมส่วนผสมต่างๆตามอัตราส่วนดังต่อไปนี้ น้ำหัวเชื้อ 1 ส่วน กากน้ำตาล 1 ส่วน น้ำ 10 ส่วน และเศษผักปริมาณ 1ใน 3 ของถังที่ใช้เตรียมปุ๋ยชีวภาพ ขั้นที่สอง ผสมน้ำ กากน้ำตาลและน้ำหัวเชื้อเข้าด้วยกัน โดยคนไปในทิศทางเดียวกัน ขั้นที่สาม เติมเศษผักลงไปแล้วจึงคนต่อจนส่วนผส

		material Second, mix the water, sugar or molasses, and the micro-organisms together. Be sure to stir in only one direction. Third, add the chopped material and continue to stir. Fourth, seal the barrel and let stand for 90 days. After 90 days the bio-fertilizer will be ready to use.	มเข้ากันดี ขั้นที่สี่ ปิดฝาถังแล้วตั้งทิ้งไว้ 15วัน เมื่อครบ15วันแล้ว ปุ๋ยชีวภาพที่ได้ก็พร้อมที่จะถูกนำไปใช้ประโยชน์
	Slide with ratios	Before applying the biofertilizer, it must be diluted appropriately. The ideal mixture 2 tbsp (30 ml) in 20 L of water.	ก่อนที่จะนำปุ๋ยชีวภาพที่ได้ไปใช้จะต้องทำการเจือจางเสียก่อน โดยผสมปุ๋ยชีวภาพปริมาณ 2 ช้อนโต๊ะหรือประมาณ 30 มิลลิลิตรกับน้ำ 20 ลิตรแล้วจึงนำไปรดบนพืชผักที่ต้องการ
25 seconds	The children smile, the farmer smile with the vegetable farm.	Choosing to replace harmful chemical fertilizers with bio-fertilizers benefits everyone. The environment benefits from the removal of unnatural chemicals. The farmer benefits from the low cost and self-reliance. So why not switch to bio-fertilizers today? The benefits of this cost effective natural solution await.	การเลือกใช้ปุ๋ยชีวภาพแทนการใช้ปุ๋ยที่เป็นสารเคมีอันตรายนั้นส่งผลดีในหลายๆด้านอาทิเช่น ทางด้านสิ่งแวดล้อมจะช่วยทำให้ดินได้มีการพักฟื้นและทำให้สารเคมีที่อยู่ในดินถูกกำจัดออกไป รวมทั้งยังเป็นประโยชน์ต่อเกษตรกรที่จะได้ใช้ปุ๋ยที่มีต้นทุนในการผลิตต่ำและได้เรียนรู้เกี่ยวกับการพึ่งพาตนเอง ด้วยเหตุนี้ อย่ามัวรอช้าที่จะนำความรู้ที่ได้เกี่ยวกับการใช้ปุ๋ยชีวภาพไปปฏิบัติเพื่อก่อให้เกิดประโยชน์ต่อทั้งตนเองและชุมชน

Biogas Video Script

Time	Video	English Audio	Thai Audio
30 sec	Shot of students disposing their lunches Shot of chicken coup	Waste, in the form of leftover food and animal manure, is a major problem in our world today. It is responsible for several environmental issues, such as…	ปัจจุบันนี้ของเสียที่มาจากเศษอาหารเหลือทิ้งและมูลสัตว์เป็นตัวการสำคัญหนึ่งที่ก่อให้เกิดปัญหาทางด้านสิ่งแวดล้อมอาทิเช่น
	Shot or picture showing air pollution	Air pollution	การเกิดมลพิษทางอากาศอันเนื่องมาจากกลิ่นเหม็นจากของเสีย
	Shot of flies on leftover food	And pathogens	หรือการมีแหล่งพาหะนำโรคที่เกิดจากการเพาะพันธุ์ของแมลงวันที่อยในกองของเสียเหล่านั้น
	Shot showing environmental management	In order to deal with these issues, a strong waste management system is required. By ensuring that waste is efficiently re-used, a cleaner and safer environment can be created for all.	ทั้งนี้เมื่อของเสียมีปริมาณมาก ระบบการจัดการของเสียจึงมีความจำเป็นอย่างยิ่งที่จะทำให้สิ่งแวดล้อมบริเวณโดยรอบมีสภาพที่ดีและถูกหลักสุขอนามัย การนำของเสียเหล่านี้มาแปรรูปให้เป็นพลังงานเพื่อนำไปใช้ประโยชน์ถือเป็นการจัดการของเสียอีกรูปแบบหนึ่งที่มีประสิทธิภาพสูง
30 sec	Shot of water	Biogas plays an important role in waste management by converting waste into useful gas through a process known as anaerobic digestion.	โครงการแก๊สชีวภาพจึงมีบทบาทสำคัญ ซึ่งสามารถนำพลังงานจากของเสียที่ผ่านกระบวนการย่อยสลายจนทำให้เกิดเป็นแก๊สชีวภาพมาใช้ประโยชน์ได้
	Shot of green field	Biogas is an environmentally friendly renewable energy source that reduces reliance on traditional petroleum fuels.	แก๊สชีวภาพนี้เป็นพลังงานทดแทนที่สะอาดและเป็นมิตรต่อสิ่งแวดล้อมซึ่งสามารถนำมาใช้เป็นเชื้อเพลิงในการประกอบอาหารที่ช่วยลดรายจ่ายในการซื้อแก๊สหุงต้มได้อีกด้วย นอกจากนี้ผลผลิตพลอยได้จากกระบวนการผลิตแก๊สชีวภาพยังสามารถนำมาใช้เป็นปุ๋ยชีวภาพ
	Shot of steamed fish (for food)	Biogas can serve as a substitute for cooking gas, reducing cooking expenses.	
		In addition, the by-product from the production of biogas can be used as a	

		biofertilzer.	
	Show the text below:	To gain all the benefits of biogas, one must first invest in the construction of a biogas plant. There are 4 main tanks in a biogas plant	จากประโยชน์ของแก๊สชีวภาพที่ได้กล่าวมานั้น การลงทุนในการทำบ่อแก๊สชีวภาพจึงถือว่าคุ้มค่าและได้ผลเป็นที่น่าพึงพอใจ โดยบ่อแก๊สชีวภาพมีส่วนประกอบหลักดังต่อไปนี้
8 sec	"Biogas Plant"		
8 sec	"Important parts of biogas plant"		
8 sec	Fill Tank	The fill tank is where the food and animal waste enters the plant	บ่อเติม (Fill Tank) เป็นบ่อสำหรับใส่วัตถุดิบที่นำมาใช้ในการผลิตแก๊สชีวภาพ
8 sec	Digester tank	The digester tank is where anaerobic digestion, the process which produces biogas, occurs.	บ่อหมัก (Digester Tank)เป็นบ่อที่กระบวนการหมักของเสียจะเกิดขึ้นเพื่อให้ได้มาซึ่งแก๊สชีวภาพ
8 sec	Overflow tank	The overflow tank helps deal with the pressure that occurs in the digester tank as a result of anaerobic digestion. It prevents gas leakages from the increasing pressure inside the digester tank.	บ่อล้น (Overflow Tank)เป็นบ่อที่มีไว้ใช้สำหรับควบคุมความดันของแก๊สที่เกิดขึ้นในบ่อหมักเพื่อป้องกันการร้าวและรั่วไหลของแก๊สจากแรงดันที่เพิ่มขึ้นภายในบ่อหมัก
8 sec	Filtration tank	The filtration tank collects the solid waste from the anaerobic digestion process. This by-product may be used as a biofertilizer.	บ่อดึงกาก (Filtration Tank)มีไว้สำหรับเก็บกากของเสียซึ่งเป็นผลพลอยได้จากกระบวนการหมักเพื่อนำมาใช้เป็นปุ๋ยชีวภาพ
40 sec	"Construction of biogas plant"	There many ways to construct a biogas plant	ทั้งนี้การก่อสร้างบ่อแก๊สชีวภาพนั้นมีหลากหลายรูปแบบ
	Pan shot around the biogas plant (Alex's animation)	Most biogas plants are dome-shaped. For your safety, constructing a biogas plant should be done under the supervision of an experienced organization.	ในที่นี้จะกล่าวถึงการก่อสร้างบ่อแก๊สชีวภาพแบบโดมโดยการก่อสร้างบ่อแก๊สชีวภาพแบบโดมนี้ควรอยู่ภายใต้การดูแลของผู้รับเหมาและวิศวกรที่มีความรู้ความสามารถในการก่อสร้างบ่อแก๊สชีวภาพให้ได้คุณภาพและปลอดภัย
	Shot of the digester tank (animation)	Begin the construction process by building a fixed dome digester tank with a 3m diameter	การก่อสร้างจะเริ่มจากการก่อสร้างบ่อหมักซึ่งมีรูปร่างแบบโดม (Fix Dome)ซึ่งมีขนาดเส้นผ่านศูนย์กลาง

			3 เมตร
	Shot of fill tank (animation)	Next, build a fill tank adjacent to the digester tank. Food and animal waste will enter the digester tank through the fill tank	จากนั้นจึงสร้างบ่อเติมให้อยู่ในบริเณใกล้กับบ่อหมักแล้วใช่ท่อเพื่อเชื่อมต่อกับบ่อหมักสำหรับเป็นทางลำเลียงให้วัตถุดิบสามารถเข้าไปในบ่อแก๊สได้
	Shot of filtration tank (animation)	Then, build a filtration tank and connect it to the bottom of the digester tank. The filtration tank collects the useful biofertilizer by-product from the digester tank	ต่อไปเป็นการสร้างบ่อดึงกากซึ่งจะเชื่อมกับบริเวณด้านล่างของบ่อหมักเพื่อให้กากของเสียที่เป็นผลผลิตพลอยได้จากกระบวนการผลิตแก๊สชีวภาพนี้สามารถไหลขึ้นมาเก็บอยู่ในบ่อดึงกากได้
	Shot of overflow tank (animation)	Build an overflow tank, which allows any excess waste to enter from the digester tanks. This also keeps the pressure inside the digester tank at a safe level.	หลังจากนั้นจึงสร้างบ่อล้นสำหรับควบคุมความดันแก๊สภายในบ่อหมัก เพราะเมื่อบ่อหมักมีความดันแก๊สมากก็จะดันให้ของเหลวภายในบ่อหมักไหลไปยังบ่อล้น
	Top view shot of the digester tank (animation)	Finally, connect a valve with two hoses to the top of the digester tank and fill it with water to check for any leaks. The hose from the digester tank can be connected to different appliances to use the biogas. For example, a hose can connect the digester tank to a stove and the gas can be used for cooking.	สุดท้ายจึงทำการติดตั้งท่อและวาล์วจากบ่อหมักและเติมน้ำบริเวณด้านบนของบ่อหมักเพื่อใช้สำหรับการตรวจสอบการรั่วไหลของแก๊ส ทั้งนี้ท่อจากบ่อหมักจะถูกเชื่อมไปยังอุปกรณ์สำหรับนำแก๊สชีวภาพที่ได้ไปประยุกต์ใช้ อาทิเช่น เชื่อมไปที่เตาแก๊สสำหรับเป็นเชื้อเพลิงในการประกอบอาหาร
30sec	Show the following text : The materials used to fill the biogas plant are: Leftover food or animal manure The first filling should be 8000kg	The materials used to fill the biogas plant are usually food waste and animal waste. The first filling should contain 8000kg of waste mixture (slurry). After that, add at least 240 kg of waste mixture (slurry) to the fill	วัตถุดิบที่ใช้เติมในบ่อแก๊สชีวภาพส่วนใหญ่ได้มาจากเศษอาหารหรือมูลสัตว์ โดยครั้งแรกควรเติมในปริมาณ 8000 กิโลกรัม หลังจากนั้นเติมอย่างน้อยวันละ 240 กิโลกรัมทุกๆวัน

	after that add slurry to the fill tank at least 240kg daily Ratio: 1:1 ratio of food waste to water 1:3 ratio of animal manure to water	tank daily However, the food or animal waste used to fill the biogas plant must first be mixed with water according to the following ratios: 1:1 ratio of food waste to water 1:3 ratio of animal waste to water	ทั้งนี้เศษอาหารหรือมูลสัตว์ที่ใช้จะต้องมีการผสมน้ำก่อน โดยอัตราส่วนระหว่างเศษอาหารกับน้ำคือ 1:1 และอัตราส่วนระหว่างมูลสัตว์กับน้ำคือ 1:3
40 sec	Preparation of food waste and water 1:1 ratio (freeze picture of pouring waste into fill tank)	Here, we will prepare the mixture of food waste and water with the ratio of 1:1	การเตรียมส่วนผสมของเศษอาหารและน้ำในอัตราส่วน 1:1ทำได้จาก
	Shot of weighing empty bucket	Weigh an empty bucket and record the weight	การนำถังเปล่ามาชั่งแล้วจดบันทึกน้ำหนัก
	Shot of food waste being poured into the bucket	Then, pour one part of food waste into the bucket	จากนั้นนำเศษอาหารมาเทลงในถังปริมาณ 1 ส่วน
	Shot of adding water into the bucket	Then add another one part of water into the bucket	แล้วจึงเติมน้ำลงไปในถังอีก 1 ส่วน
	Shot of stirring the mixture in the bucket	Stir to mix the food waste and water evenly before pouring it into the fill tank	คนให้เศษอาหารและน้ำกลายเป็นเนื้อเดียวกันจึงนำมาเทลงในบ่อเติม
40 sec	Preparation of animal waste to water 1:3 ratio (freeze picture of pouring animal waste into the fill tank)	Prepare the mixture of animal waste and water with the ratio of 1:3	การเตรียมส่วนผสมของมูลสัตว์และน้ำในอัตราส่วน 1:3ทำได้จาก
	Shot of weighing empty bucket	Weigh an empty bucket and record the weight	การนำถังเปล่ามาชั่งแล้วจดบันทึกน้ำหนัก
	Shot of animal waste being poured into the bucket	Then, pour one part of animal waste into the bucket	จากนั้นนำมูลสัตว์มาเทลงในถังปริมาณ 1 ส่วน
	Shot of adding water into the	Then add three parts of water into the bucket	แล้วจึงเติมน้ำลงไปในถังอีก 3 ส่วน

	bucket		
	Shot of stirring the mixture in the bucket	Stir to mix the animal waste and water evenly before pouring it into the fill tank	คนให้มูลสัตว์และน้ำกลายเป็นเนื้อเดียวกันจึงนำมาเทลงในบ่อเติม
20 sec	Show the following text: Food waste and water with the ratio of 1:1 16kg Animal waste and water with the ratio of 1:3 60kg Total weight = 76kg	In this example, the mixture of one part of food waste and one part of water is about 16kg and the mixture of one part of animal waste and three parts of water is about 60kg. These will be combined to give 76kg of total waste.	ส่วนผสมของเศษอาหาร 1 ส่วนกับน้ำ 1 ส่วนซึ่งมีปริมาณ 16 กิโลกรัมจะถูกนำมาคิดรวมกับส่วนผสมของมูลสัตว์ 1 ส่วนกับน้ำ 3 ส่วนซึ่งมีปริมาณ 60 กิโลกรัมเพื่อให้ทราบถึงน้ำหนักของวัตถุดิบจากของเสียทั้งหมดที่เติมลงในบ่อหมัก โดยในที่นี้รวมน้ำหนักของเสียที่ใช้เป็นปริมาณ76 กิโลกรัม
20 sec	Show diagram of biogas plant	After filling the waste into the fill tank for the first time, wait 7 days for gas to form. During this time, anaerobic digestion will take place, creating the useful biogas. After that, put waste mixture in the fill tank daily if possible. There are several factors that need to be controlled:	หลังจากการเติมวัตถุดิบลงในบ่อเติมครั้งแรกแล้วรอประมาณ 7 วันเพื่อให้สารอินทรีย์ต่างๆถูกย่อยสลายโดยเชื้อจุลินทรีย์ในสภาพปราศจากออกซิเจน(anaerobic digestion)จนทำให้เกิดแก๊ซชีวภาพซึ่งเป็นแก๊สผสมที่มีส่วนประกอบหลักคือแก๊สมีเทน ซึ่งมีคุณสมบัติติดไฟได้ง่าย การตรวจสอบปัจจัยที่มีผลต่อกระบวนผลิตแก๊สชีวภาพจะทำขึ้นเมื่อครบ 7 วันหลังจากการเติมวัตถุดิบครั้งแรกและทำหลังจากนั้นอย่างสม่ำเสมอ โดยปัจจัยต่างๆที่ต้องควบคุมได้แก่
15 sec	Shot of testing gas leakage (freeze) Unfreeze picture	Gas Leakage Gas leakage can be observed from water at the opening to the digester tank. If there is any leakage, bubbles will form in the water.	การตรวจสอบการรั่วไหลของแก๊ส การรั่วไหลของแก๊สสามารถดูได้จากน้ำที่อยู่บริเวณด้านบนของ บ่อหมัก ถ้าหากไม่มีฟองอากาศปรากฏแสดงว่าแก๊สภายในบ่อหมักไม่เกิดการรั่วไหล
15 sec	Shot of measuring temperature with thermometer (freeze) Unfreeze picture	Temperature Measurement The suitable temperature for the anaerobic digestion process ranges from 20-45 degrees Celsius. The temperature will be measured by using a	การวัดอุณหภูมิ อุณหภูมิที่เหมาะสมในการเกิดกระบวนการ ย่อยสลายแบบปราศจากออกซิเจนนั้นจะอยู่ในช่วง 20– 45 องศาเซลเซียส

		thermometer to check the liquid from the overflow tank	ทั้งนี้การตรวจสอบจะทำได้จากการนำน้ำจากบ่อล้นมาวัดอุณหภูมิโดยใช้ปรอท
30 sec	Shot of measuring pH (freeze)	pH Measurement The pH value will determine the acidity in the biogas plant. Lower pH indicates an acid while higher pH indicate a base. The suitable pH values range from 7-7.2, which indicates a neutral liquid.	การวัดค่า pH ค่า pH จะเป็นตัวบ่งชี้ถึงสภาพความเป็นกรดและเบส โดยยิ่งค่า pH น้อยสภาพความเป็นกรดจะมาก และค่า pH มากสภาพความเป็นเบสจะมาก โดยค่า pH ที่เหมาะสมในกระบวนการหมักจะมีสภาพเป็นกลางซึ่งจะอยู่ในช่วง pH 7-7.2
	Shot of measuring pH with universal indicator	The measurement can be done by testing the liquid from the overflow tank with a universal pH indicator	การตรวจสอบจะทำได้จากการนำน้ำจากบ่อล้นมาทดสอบกับกระดาษยูนิเวอร์แซลอินดิเคเตอร์แล้วเปรียบเทียบสีของกระดาษยูนิเวอร์แซลอินดิเคเตอร์กับแถบสีมาตรฐาน หรือถ้าหากมีเครื่องวัด pH (pH meter)ก็สามารถทำการสอบเทียบมาตรฐาน(Calibration)แล้วจึงนำมาจุ่มในน้ำตัวอย่างซึ่งเครื่องวัด pH นี้จะสามารถบอกได้ทั้งค่า pH และอุณหภูมิที่ถูกต้องแม่นยำ
	Shot of measuring pH with pH meter	This measurement can also be done by testing the liquid from the overflow tank with a pH meter.	
	Shot of adding food waste	If the liquid from the overflow tank is too basic, adjust the pH by adding more food waste or animal waste into the biogas system to make it more acidic	ทั้งนี้หากสภาพของน้ำในบ่อล้นมีค่าเป็นเบสมาก จะต้องทำการปรับสภาพของระบบการผลิตแก๊สชีวภาพโดยการนำเศษอาหารหรือมูลสัตว์ที่มีฤทธิ์เป็นกรดเติมลงไปในบ่อเติม แล้วจึงวัดค่า pH อีกครั้งหนึ่ง
	Shot of adding limestone (calcium carbonate)	If the liquid from the overflow tank is acidic, adjust pH by adding limestone (calcium carbonate) to make it more basic.	แต่ถ้าสภาพของน้ำในบ่อล้นมีค่าเป็นกรดมาก จะต้องทำการปรับสภาพของระบบการผลิตแก๊สชีวภาพโดยการเติมปูนขาว (Calcium Carbonate) ที่มีฤทธิ์เป็นเบส แล้วจึงวัดค่า pH อีกครั้งหนึ่ง

10 sec	Shot of boiling water	When used for cooking, Biogas can effectively boil 5 liters of water in just 10 minutes which reduces the money spent on traditional cooking gas by 25% each month	แก๊สชีวภาพที่ได้นั้นสามารถต้มน้ำปริมาณ 5 ลิตรภายในเวลา 10 นาทีได้อย่างมีประสิทธิภาพ และยังช่วยลดปริมาณการใช้แก๊สหุงต้มได้ถึง 25% ต่อเดือนซึ่งเป็นการช่วยประหยัดรายจ่าย
20 sec	Shot of mixing the liquid from overflow tank with water Shot of watering plants with biofertilizer	In addition, the by-product of the biogas production process can be used as biofertilizer. Mix one part of the liquid from the overflow tank with 20 parts of water. Water plants with this mixture to make them healthy and strong. Once it has dried, the solid residue can also be used as compost	นอกจากนี้ผลผลิตพลอยได้จากแก๊สชีวภาพสามารถนำมาใช้เป็นปุ๋ยชีวภาพได้ โดยการนำน้ำจากบ่อล้น 1 ส่วนผสมกับน้ำ 20 ส่วน แล้วนำไปรดบนพืชผัก เพื่อให้พืชผักแข็งแรงและปลอดสารพิษ อีกทั้ง กากของเสียที่นำไปตากแห้งแล้วสามารถนำมาใช้เป็นส่วนผสมของปุ๋ยชีวภาพได้อีกด้วย
20 sec	Shot showing conclusion of biogas	The production of biogas can efficiently dispose of waste by turning every-day items such as food waste and animal waste into a useful, renewable energy source.	โครงการแก๊สชีวภาพ นอกจากจะนำของเสียมาเปลี่ยนเป็นพลังงานแล้ว ยังช่วยแก้ปัญหาการปล่อยของเสียสู่สภาพแวดล้อม อีกทั้งสามารถนำการเรียนการสอนรายวิชาต่างๆมาบูรณาการเข้ากับเนื้อหาความรู้เกี่ยวกับกระบวนการและขั้นตอนในการทำแก๊สชีวภาพได้อีกด้วย
5 sec	Shot of Brochures	Refer to our Biogas Brochures for more information	

Appendix H

Suggested questionnaire to assess educational videos. The correct answer is bolded.

Wood Vinegar Procedure Questions

1. When does the wood vinegar collection process begin, and how do you know when it ends?
    a. **It starts when a strong smoke appears from the asbestos pipe and ends when the droplets are dark in color.**
    b. It starts when a strong smoke appears from the asbestos pipe and ends when the other end of the bamboo pipe is emitting smoke
    c. It starts when the wood is burning in the kiln and ends when the droplets are dark in color.

2. Why is the bamboo pipe wrapped in wet towels?
    a. To keep the bamboo pipes cold.
    b. **To promote condensation.**
    c. To prevent the droplets from coming.

3. After the collection process, the liquid separates into 3 layers. Which layer is the usable wood vinegar?
    a. The top layer.
    b. **The middle layer.**
    c. The bottom layer.

4. Why is it recommended to continue burning the wood in the kiln, even after the collection process is over?
    a. **To produce usable charcoal.**
    b. To make more heat.
    c. To make more wood vinegar.

Biofertilizers Procedure Questions

1. Why is a central depression made when the material is placed into the 50cm diameter bucket?
    a. **To allow heat to escape.**
    b. To make it look interesting.
    c. To make the air flow faster.
2. How often should the micro-organism collection mix be checked and stirred?
    a. **Every 4 days.**
    b. Every 7 days.
    c. Every 15 days.
3. How long does the fermentation process usually take? What is the visible sign that indicates the end of this process?
    a. It takes around 30 days and the sign is that the product has no smell.
    b. It takes around 7 days and the sign is that the product smells like alcohol.
    c. **It takes around 30 days and the sign is that there is a visible white layer and it smells like alcohol.**
4. How long should the biofertilizers production mixture be allowed to sit before it is finished?
    a. 15 days.
    b. **30 days.**
    c. 90 days.
5. True or **False**: The micro-organism cultivation mixture should be stirred in both directions.

Biogas Procedure Questions

1. What are the 4 tanks used in this process?
    a. **Digester tank, Overflow tank, Filtration tank, Fill tank**
    b. Overflow tank, Water tank, Food tank, Manure tank
    c. Filtration tank, Digester tank, Food tank, Manure tank

2. In what ratio is the manure mixed with water?
    a. 7 to 1
    b. 3 to 1
    c. 1 to 1
3. How much organic matter should initially be added to the digester?
    a. 2,000 kg
    b. 6,000 kg
    c. 8,000 kg
4. How long after the initial addition of organic matter does it take for the biogas to form?
    a. 2 days
    b. 7 days
    c. 15 days
5. What is the ideal pH in the digester? How can pH be changed to reach the desired level?
    a. 7.0 – 7.2. Add more leftover food if it is acidic and calcium carbonate if it is basic.
    b. 6.5-7.5. Add sodium if it is acidic and chlorine if it is basic.
    c. 7.0 – 7.2. Add calcium carbonate if acidic or more leftover food if it is basic.
6. What is the ideal temperature of the digester?
    a. 17 degrees Celsius.
    b. Between 20 and 45 degrees Celsius.
    c. Between 5 and 10 degrees Celsius.

Additional Questions on the Benefits of Different Sustainable Development Projects

1. How do you think the use of sustainable practices such as the ones used to make wood vinegar benefit the school? How would it benefit other communities?

2. Do you think you will have any use for these projects at your school? Could it be used as part of an active curriculum to teach your students about sustainability?

Additional Questions on the Appeal of the Educational Videos

1. Did you maintain interest while watching the videos?
2. Was the content in the video well understood? Was it portrayed in a clear manner?
3. Would you recommend this video to anyone else?

Do you have any other suggestions that could help make this video more effective and easier to watch?