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February 3, 2012

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Abstract

The “Student Internship Project in Science and Technology-based Microenterprises” is a curriculum enhancement intervention executed through “hands-on” internship across Agriculture, Forestry and Natural Resource (AFNR) courses in three State Universities and Colleges (SUCs) in Region IX, Philippines. With the goal of reversing the declining enrolment trend, its four components (Coconut Sugar, Seaweeds, Tissue Culture and Rubber Seedlings) operate on experiential and pragmatic approach to enhancing the competence and institutional employability of students through science and technology utilization, acquisition of entrepreneurial skills and microenterprise development focusing on Zamboanga Peninsula’s major dollar-earning export commodities. The immersion of 362 student-interns has developed their technical and entrepreneurial skills that can match the requirements of local agriculture-based industries which they can also use to start home-based microenterprises should they opt for self-employment after graduation. The project is also able to reverse the declining enrollment in different courses in the Zamboanga Peninsula region. From School Year 2007-2008 to School Year 2010-2011, the project is one of the factors that contributed to the overall three-percent increase in enrollment in AFNR courses in the three participating SUCs in the region. As a result of the student-internship program, the students produced consumer goods, planting materials and semi-processed products from the four commodities which are sold through grocery stores and directly to “walk-in” buyers, traders, farmers, local government units, non-government organizations.
1. INTRODUCTION

The “Student Internship Project in Science and Technology-based Microenterprises” (WMSU-AFNR Project 3.1k) reinforces Philippines-Zamboanga Peninsula (ZamPen) Regional Development Plan via higher education capability building initiative with anticipated impact in the agriculture and employment sectors and contribution to poverty reduction especially in the rural areas. The four project components (coconut sugar, deep sea seaweeds, budded rubber seedlings and tissue cultured banana plantlets/seedlings) belong to ZamPen’s largest export-earning commodities and the biggest sources of employment and livelihood. The raw materials—mostly derived from coconut, banana, seaweeds and rubber—provide various Science and Technology (S&T) applications and avenues for entrepreneurship in processing for product development and quality improvement with value-added contributions to commercial and industrial uses and sustainable livelihood of farmers and fishermen in the region.

The project is a university-based and student-centered internship in S&T cum entrepreneurship education focusing on enhancing the technical skills, competence and institutional employability of AFNR students through S&T applications and entrepreneurial skills acquisition in agri-based production and processing technologies, product standardization, quality improvement and overall management and development of financially viable micro and small enterprises along the region's major dollar-earning export commodities. These involve food items (coconut sugar, coconut honey and coconut jelly), additive to industrial and medical products (carrageenan produced from dried seaweeds) and planting materials for rubber plantations (budwood and seedlings) and banana farms (tissue cultured banana plantlets and seedlings). It also serves as the venue for "hands on" S&T cum entrepreneurship-based laboratory exercises and in-campus internship or on-the-job training (OJT) program. Through the project, the 362 AFNR student-interns—the main beneficiaries—produce 10 different product lines available for sale to interested buyers: coco sugar, jelly, jam, wet and dried seaweeds, rubber budwood and seedlings, tissue cultured plantlets and seedlings.

The project’s sustainability across the three implementing State Universities and Colleges (SUCs) in ZamPen relies on the absorptive capacity and financial viability of the existing IGPs. After December 2010, AFNR Project 3.1k is now integrated with regular IGPs and the internship components of the AFNR curricula of the three largest SUCs in Region IX such that the project is now under the supervision of Business/IGP Units. Additional investments to continue, expand or sustain project operations beyond the DOST-funded AFNR program will already come from the budget of the SUCs or from the project’s gross income which is currently deposited in the special trust funds of Western Mindanao State University (WMSU), Jose Rizal Memorial State University-Tampilisan Campus (JRMSUT) and Zamboanga State College of Marine Sciences and Technology (ZSCMST).

2. EDUCATION, SCIENCE AND TECHNOLOGY, AND ENTREPRENEURSHIP

Education, science and technology (S&T) and entrepreneurship are the three of the most indispensable pillars and primary drivers of national economic development. The direct contributions of education, S&T and entrepreneurship to national development around the world are well-documented and
evidenced by the rapid economic development of the Asian Tigers (Hongkong, Taiwan, South Korea and Singapore) and recently China. Sectoral interdependence among these primary drivers of economic development is largely anchored on higher education providing the training ground and the capability enhancement tools thereby enabling graduates and students to acquire the knowledge, skills, attitudes and practices necessary for the advancement, applications and utilization of S&T, generation of profit-maximizing values from S&T-based commodities, and greater financial yields for the economic agents such as the “entrepreneur.”

Scientific knowledge and appropriate technologies are still considered central to resolving the economic, social and environmental problems that make current development paths unsustainable. S&T are rightly considered to be vital for creating wealth and improving the quality of life in contemporary society. It is also S&T which brings to us everyday technologies that preserve our foods, cool our houses and make life much easier for us (Khan 2004:165). The importance of science and technology (S&T) as key drivers of growth is stressed in economic theory, especially endogenous growth theory as well as in many economic/development strategies of countries or group of countries (Bucar 2010:5).

The survey of Vanessa Peña, et. al., (2010:3) on entrepreneurship education in the USA is premised on entrepreneurship as one driver of innovations that propel and sustain economic growth. Citing Klaus Schwab, Founder and Executive Chairman of the World Economic Forum, “Entrepreneurship is the engine fuelling innovation, employment generation, and economic growth.” With rare exception, entrepreneurship is perceived to be the engine driving all economies regardless of the political system, as countries emulate and adapt the best the United States has to offer.

In the Philippines, improving access to and success in higher education remains a challenge, along with the need to improve the quality of graduates in preparation for future work. In relation to increasing demand for broader skills in the knowledge market, the system calls for more sustained efforts to enable both industry and agriculture to assimilate and utilize new and tested knowledge for higher productivity and greater competitiveness (MTPDP 2004-2010:218). Hence, an effective university-industry match in these agricultural commodities and technologies ensures that AFNR students and graduates are able to learn and acquire the skills that perfectly fit the requirements of the industry. Complementing agricultural and economic development is the production of skilled agricultural manpower by the universities in the region. When agricultural curricula are similarly focused on regional flagship commodities, the universities are better able to respond adequately to the industry’s demand for skilled manpower. A strong academic orientation and practical experiences on the region’s flagship commodities (production, processing and entrepreneurship) ensures that knowledge and skills of agriculture graduates actually match the needs of the industry. In this way, well-trained graduates will be in a better position to positively contribute to the improvement and productivity of the agri-fishery industry.

3. AGRICULTURE SITUATIONER AND REGIONAL DEVELOPMENT: ZAMBOANGA PENINSULA (REGION IX)

Agriculture is the bedrock of the rural economy. It is in the rural areas where most Filipinos, including the country’s labor force, live. A majority of them are poor. Agriculture is the major source of raw resources on which the rest of the economy depends. It accounts for 20 percent of the gross national
product, or one-fifth of the economy, while one-third of the population is employed in agriculture or agriculture-related industries (MTPDP 2004-2010:23).

ZamPen is primarily an agricultural region. NEDA Region IX reports that in year 2009, the primary regional economic growth driver was the Agriculture and Fishery in the Agriculture Sector. While remaining to be the primary driver of the regional economy contributing about half of its total employment and output, the Agriculture Sector’s contribution to gross regional output is declining from 53.3 percent in 2001 to 48.7 percent in 2008. The economy of Zamboanga Peninsula is still predominantly agriculture-based driven and accounting for about forty (40) percent of the regional output and almost fifty (50) percent of the total employment of Region IX. Agriculture accounts for about 50 percent of employment in Region IX. Except for Zamboanga City, wherein employment is heavily concentrated in the Services Sector, the major concentration of employment for the rest of the provinces is in agriculture. Historical data shows that in terms of class of workers, about 45.5 percent are Own-Account Workers, in which 38.2 percent comprise self-employed persons and 7.32 are employers. Wage and Salaried Workers comprise 36.5 percent of those employed, and more than 18.0 percent are Unpaid Family Workers (NEDA IX).

The 2009 Regional Development Report for Zamboanga Peninsula (NEDA IX:3-7) shows a net 6.7% decline in the total enrolment in Agriculture, Forestry and Fisheries courses from 1,122 in SY 2008-2009 to 1,047 in SY 2009-2010. Moreover, total enrolment in AFNR courses for SY 2009-2010 represents only 1.73% of the total number of 60,356 students enrolled in various disciplines in different higher education institutions in Region IX. Overall, ZamPen’s total enrollment in higher education institutions dropped by 22.3% from a total of 77,662 to 60,356 students enrolled in various disciplines for the same period. This declining enrollment in the AFNR courses is a national phenomenon with other regions experiencing drops in enrollment every school year. The national government has officially recognized this as an alarming situation needing immediate solution to be implemented nationwide.

3.a. ZamPen’s Major Export Commodities

The 2009 Regional Development Report for Zamboanga Peninsula (NEDA IX), identifies the top five (5) major/champion crops produced in 2009 include: coconut at 1,744,738.04 M.T. followed by banana at 261,081.43 M.T., rubber at 164,293.44 M.T., mango at 57,509.36 M.T. and cassava at 30,416.06 M.T. Moreover, the fisheries sub-sector is considered as one of the major contributors to the regional economy. The region is endowed with rich fishing grounds and with rich fish and aqua-marine resources. The year 2009 saw a 13.62 percent increase in fisheries production. From its level of 644,386 metric tons in 2008 it increased to 732,146 metric tons or by 13.62 percent. Commercial fishing remains to be the leading contributor of the fishery sector with a production of 357,429. It also manifested the highest increase of 28.93 percent over the previous year’s production. This was followed by the aquaculture subsector which contributed 247,634 metric tons. Moreover, while the Philippines is identified by the Food and Agriculture Organization (2005) as the world’s top exporter of raw and processed seaweeds or carrageenan, the ZamPen region, according to BFAR (2008), is also one of the country’s top seaweeds producer.

3.a.1. Coco Sugar

Philippine Coconut Authority Region 10 Manager Luis G. Cruz says coconut sugar has great potential as a natural and cheaper alternative for synthetic sweeteners in the market (Banos 2010).
latest discovery is that coconut sap sugar has been clinically tested as the best sugar substitute for diabetics and health buffs, as it is without side effects, says the Philippine Coconut Authority (Philcoa). Erlene C. Concibido-Manohar, Philcoa project development officer, said that the brown-colored coconut sap sugar is derived not from the nut but from the toddy or sweet sap from which the locally made wine tuba is also made. It is natural sweetener besting other sugar in the market. Manohar says that laboratory tests at the University of the Philippines confirm that its content sugar level is 12-18 percent. Based on a 2007 Food and Nutrition Research Institute (FNRI) study, the glycemic index (GI) of coconut sap sugar was 35; hence it is classified as a low-GI food, which can be used as natural sweetener for diabetics. GI is a ranking system for carbohydrates based on its immediate effect on blood glucose levels. “The lighter the number, the greater the blood sugar response,” she says. A low-GI food will cause a small rise in blood glucose level, while a high-GI food will trigger a dramatic spike (Manila Bulletin, 29 April 2008).

3.a.2. Seaweeds

Being introduced as a potential income earner, the seaweed industry has contributed to the country’s economy both in the areas of export and local industries raw material. It is even considered as a “sunrise” industry among SIAP (Seaweed Industry Association of the Philippines pioneer members. As a source of livelihood, seaweed farming in the country has grown steadily with over half the world's supply of carrageenan production coming from the country. In 1999, about one million Filipinos, mostly Muslims, have directly benefited from the country’s seaweed farming industry producing 700,000 tons of dried seaweeds worth 129 million USD. The thrust for the seaweed development is to increase production through improvement of culture techniques, postharvest and processing activities for a sustainable economic activity among cultural minorities engaged in seaweed production as a livelihood in Region 9 as a priority area of support in Mindanao.

3.a.3. Rubber

The Local Government Units (LGUs) and the Department of Agriculture (DA) are one in saying that rubber is one of the most profitable agro-industrial crops in the Philippines and has a Promising potential to be globally competitive. “From 1991 to 1995, the rubber industry garnered 17 percent of the annual sales for agricultural products, contributing from P5.1 to P9 billion in total sales. In 1996, 40 percent of our natural rubber production was exported which raised our income from $10 million in 1986 to a whopping $34 million. In 2000, we produced 6.6 million tons of natural rubber and by the year 2010, it is predicted that we could produce as much as 9.1 million tons”, reported Dir. Nicomedes P. Eleazar of the Bureau of Agricultural Research (BAR). Agriculture Secretary Domingo F. Panganiban, on the other hand, stated that the DA strives to increase rubber production by 10 percent annually to expand our market. It also recommends integrated farming systems approach to achieve a 10 percent yearly raise in the income of rubber smallholders (Mojica 2008).

3.a.4. Tissue Culture

Plant tissue culture comprises a set of in vitro techniques, methods and strategies that are part of the group of technologies called plant biotechnology. Tissue culture has been exploited to create genetic variability from which crop plants can be improved, to improve the state of health of the planted material and to increase the number of desirable germplasms available to the plant breeder. The culture of single cells and meristems can be effectively used to eradicate pathogens from planting material and thereby dramatically improve the yield of established cultivars. Large-scale micropropagation laboratories are
providing millions of plants for the commercial ornamental market and the agricultural, clonally-propagated crop market. With selected laboratory material typically taking one or two decades to reach the commercial market through plant breeding, this technology can be expected to have an ever increasing impact on crop improvement. The application of tissue-culture technology, as a central tool or as an adjunct to other methods, including recombinant DNA techniques, is at the vanguard in plant modification and improvement for agriculture, horticulture and forestry (Brown and Thorpe 1995).

4. STUDENT INTERNSHIP PROJECT IN SCIENCE AND TECHNOLOGY-BASED MICROENTERPRISES (AFNR PROJECT 3.1K)

AFNR Project 3.1k is a university-based and student-centered internship in entrepreneurship education cum S&T applications in the processing and production, management as well as marketing of food items (coconut sugar, coconut honey and coconut jelly), additive to industrial and medical products (carrageenan produced from dried seaweeds) and planting materials for rubber (budded rubber seedlings) and banana (tissue cultured plantlets and seedlings) plantations.

The project aims to achieve three objectives:

1. To provide practical and hands-on learning experiences to AFNR students on the integration of S&T and entrepreneurship;

2. To increase enrollment in AFNR courses by improving the employability of AFNR graduates through technical and managerial internship in agri-based enterprises with high S&T content; and

3. To use the Project as a site and a showcase (demo farm) for the hands-on learning experiences in terms of application and testing of technologies and improve technical know-how and entrepreneurial abilities of AFNR students and unemployed graduates as well as develop the local production, processing and entrepreneurship/income-generating capabilities of the SUCs in the ZamPen region.

4.a. Conceptual Framework

The project’s conceptual framework is operates on the experiential and pragmatic approach to the enhancement of the competence and institutional employability of AFNR students and graduates through application of S&T and acquisition of entrepreneurial skills in agri-based as well as home-based production and processing ventures, product standardization, quality improvement and overall management and development of financially viable microenterprises along the region's agricultural flagship and champion as well as major dollar-earning export commodities. It also served as the venue for "hands on" S&T cum entrepreneurship-based laboratory exercises and in-campus internship or on-the-job training (OJT) program. The AFNR students were given respective responsibilities and accountabilities in all aspects of the operations, management and development of each of the ten students' Income-Generating Project (IGPs) or micro-enterprises: production and operations, sales and marketing, credit and collection, accounting and auditing as well as the overall financial management.
5. METHODOLOGY

The main implementation methodology used in the AFNR Project 3.1k is internship—which is a form of training—through deployment of AFNR students in the operations, production, marketing and overall management of four projects that produce coco sugar, seaweeds, rubber seedlings and banana plantlets/seedlings for sale to interested buyers.

Students’ internship officially started after completion of pertinent trainings of selected AFNR students (under AFNR Project 2) in the four sub-projects (coco sugar, seaweeds, rubber and tissue culture). While trainings are on-going, all project staff prepared all the inputs necessary for the internship especially the raw materials to be used in the production and processing as well as marketing linkages and tie-ups with different government, non-government and business organizations in the locality.

AFNR Project 3.1 was implemented as guided by four major criteria that blend the elements of S&T application and utilization with entrepreneurial activities in the administration of curriculum enhancement via the training/internship program in educational income-generating projects (E-IGP) for AFNR students in three SUCs in the Zamboanga Peninsula region (Region IX).

6. FINDINGS

As an educational improvement intervention, the goal of WMSU-AFNR Project 3.1 is to enhance the AFNR undergraduate curriculum, enable the students and graduates to be more prepared and be able to meet the knowledge and skills required for employment in the AFNR industries, and add more value to pragmatic and “hands-on” learning experiences in S&T applications and entrepreneurship along the region’s four major commodities (coconut, seaweeds, rubber and banana tissue culture). Internship in educational income-generating projects (e-IGP) is the main mode of delivering the AFNR curriculum enhancement program and improvement in the knowledge and skills of AFNR students.

Findings are laid down in accordance to the objectives of the project. Overall outcomes of the project across the participating SUCs in ZamPen are well-appreciated by university officials due to the availability of funds which enable them to easily acquire the raw materials to be used in the establishment of enterprise and the processing of target commodities into products with higher economic value. Also, well-appreciated is the enhancement of the knowledge and skills of AFNR students in making use of their newly acquired skills as a platform for making a viable livelihood in their community helped build their confidence as well as help dissipate their fear of becoming jobless after graduation. Since employment in the industries may be limited, the graduates are well-equipped with knowledge in examining available employment alternatives in their respective communities and in maximizing the use of locally available resources for self-employment options or entrepreneurship.

Objective #1. To provide practical and hands-on learning experiences to AFNR students of the integration of Science and Technology (S&T) and entrepreneurship.
AFNR Project 3.1 has immersed a total of 362 students from the three SUCs in ZamPen, thereby accomplishing 139 percent of the 260 target number of student-interns. The immersion covers S&T application in terms of processing the four commodities (coco sugar, seaweeds, rubber and tissue cultured bananas) into products that can be sold directly to interested buyers. During the immersion are also exposed to some entrepreneurial exercises such as institutional and direct selling and bookkeeping and accounting. Student-interns produce all the products currently available for sale in WMSU, ZSCMST and JRMSU-Tampilisan. Entrepreneurial activities during internship are done in the last phase and after production of the marketable products. Interns were assigned to contact possible buyers and discuss the possibility of their becoming a supplier of the commodity. The easier task for the interns is direct selling of the products to interested buyers.

Actual exposure and immersion of AFNR students in all the operational aspects of the sub-components for one semester and enabling them to apply the process and technology learned during the trainings provides the “hands-on” learning experiences of the students in the S&T applications. On the other hand, their actual direct selling activities of the processed products gave them sufficient confidence in the entrepreneurial aspects of their internship. Across the four sub-components, student-interns perform actual tasks in processing, marketing, selling and other procedures:

1. Coco Sugar—harvesting toddy, cooking, drying, pulverizing, packing, selling
2. Seaweeds—area preparation, planting, harvesting, drying, packing, selling
3. Rubber—budwood preparation and care, transplanting, nurturing and growing of seedlings, selling
4. Tissue Culture—laboratory tasks in mixing chemicals, extracting parts of the mother plants which can be grown to plantlets, caring of plantlets under laboratory conditions, and transplanting and other nursery activities for growing banana plantlets into seedlings and selling of plantlets and seedlings.

Student Immersion in AFNR Project 3.1

When the 362 AFNR student-interns immersed in the four components were grouped according the degree programs the students were taking in the SUCs, the biggest group of interns immersed in the project were the students taking up Diploma in Agricultural Technology (DAT)/Bachelor of Agricultural Technology (BAT). However, the highest percentage of accomplishments came from the BS Fisheries group as a result of the lower target assigned to BS Fisheries in the conceptualization and planning stages of the project (Table 1). However, the department chair became very cooperative during the implementation stage wherein most of the BS Fisheries students were required to undergo internship in the project. While the DAT/BAT group has the largest number of interns, it did not get the highest percent accomplishment due to higher number of target students assigned because in the proposal stage, it was already agreed that all DAT/BAT students enrolled in the WMSU-College of Agriculture will be required to undergo internship in the project.
### Table 1

**Student-Interns Immersed by Course**

<table>
<thead>
<tr>
<th>Course</th>
<th>Target</th>
<th>Actual</th>
<th>Percent (%) Accomplishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS Aquaculture</td>
<td>10</td>
<td>13</td>
<td>130</td>
</tr>
<tr>
<td>BS Fisheries</td>
<td>8</td>
<td>77</td>
<td>963</td>
</tr>
<tr>
<td>BS Marine Biology</td>
<td>7</td>
<td>22</td>
<td>314</td>
</tr>
<tr>
<td>BS Marine Technology</td>
<td>60</td>
<td>50</td>
<td>83</td>
</tr>
<tr>
<td>BS Agriculture</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>BS Agribusiness</td>
<td>50</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Diploma/Bachelor of Agricultural Technology</td>
<td>70</td>
<td>110</td>
<td>157</td>
</tr>
<tr>
<td>BS Agricultural Engineering</td>
<td>5</td>
<td>10</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>260</strong></td>
<td><strong>362</strong></td>
<td><strong>139</strong></td>
</tr>
</tbody>
</table>

When the number of AFNR student-interns immersed in the four components were grouped according to commodity or project component, the largest number of students who were immersed in seaweeds farming, processing, marketing and selling were in the seaweeds commodity (167 students), which is 139 percent higher than the expected output (Table 2). This resulted from the larger number of students enrolled in ZSCMST and the decision of the school to require their AFNR students to undergo internship in the project. Rubber, on the other hand, had immersed only 51 percent of the target. This is again a result of limited enrolment in the AFNR courses in JRMSU in Tampilisan, Zamboanga del Norte.

### Table 2

**AFNR Student-Interns Immersed by Commodity**

<table>
<thead>
<tr>
<th>SUC</th>
<th>Total</th>
<th>Percent (%) Accomplishment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Target</strong></td>
<td><strong>Actual</strong></td>
</tr>
<tr>
<td>Coco Sugar (WMSU)</td>
<td>80</td>
<td>82</td>
</tr>
<tr>
<td>Tissue Culture (WMSU)</td>
<td>40</td>
<td>77</td>
</tr>
<tr>
<td>Seaweeds (ZSCMST)</td>
<td>70</td>
<td>167</td>
</tr>
<tr>
<td>Rubber (JRMSU-T)</td>
<td>70</td>
<td>36</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>260</strong></td>
<td><strong>362</strong></td>
</tr>
</tbody>
</table>

The 362 AFNR student-interns who were immersed in the four flagship commodities of the ZamPen region have acquired sufficient know-how and had the practical and hands-on learning and experiences in the project in terms of S&T application in processing and packaging as well as in making business (entrepreneurship) out of the results and products produced from processing. The actual exposure in the products has developed their confidence in the replication of their experiences when they graduate from college and make use of this experience as a take-off point for improving their income-generating capabilities when they return to their respective communities. Moreover, the project has given
the student-interns an edge over other students in terms of knowledge, field experience and practical skills when they will apply for employment in the industries and corporations.

**Production, Sales and Inventory**

The project has produced different products that are ready for sale valued at Php807,254.00 as of March 31, 2011. Sales, however, was Php220,814.00 which represents on 27.4 percent of the total value of goods produced (Table 3). Top moving products (all items sold and no inventory) are coco jelly and coco honey because of consumer preference for the product, meaning that, they are more saleable than coco sugar because these items can be used in sandwich spread and substitute for butter, cheese and margarine. While these items were re-processed from coco sugar that hardened and could not be crystallized into sugar form, these proved to be less expensive, more saleable and have more uses to consumers than the coco sugar.

### Table 3

**Total Production, Sales and Inventory of Products under AFNR Project 3.1**

<table>
<thead>
<tr>
<th>Item Sold</th>
<th>Selling Price/ Unit</th>
<th>Total Quantity Produced</th>
<th>Value of Production (PhP)</th>
<th>Quantity Sold</th>
<th>Total Sales (PhP)</th>
<th>Performance (% of sales to production)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coco Sugar</td>
<td>Php200/kg</td>
<td>858.62kg.</td>
<td>171,724</td>
<td>446.87kg</td>
<td>89,374</td>
<td>52%</td>
</tr>
<tr>
<td>Coco Jelly</td>
<td>Php40/bot</td>
<td>100 bots</td>
<td>4,000</td>
<td>4,000 bots</td>
<td>4,000</td>
<td>100%</td>
</tr>
<tr>
<td>Coco Honey</td>
<td>Php35/bot</td>
<td>150 bots</td>
<td>5,250</td>
<td>5,250 bots</td>
<td>5,250</td>
<td>100%</td>
</tr>
<tr>
<td>Seaweeds</td>
<td>Php50/kg</td>
<td>161 kgs</td>
<td>8,050</td>
<td>69 kgs</td>
<td>3,450</td>
<td>43%</td>
</tr>
<tr>
<td>Rubber Seedlings</td>
<td>Php15/pc</td>
<td>30,000</td>
<td>450,000</td>
<td>2,168 budded seedlings</td>
<td>65,040</td>
<td>15%</td>
</tr>
<tr>
<td>Tissue Cultured Banana seedlings</td>
<td>Php25/pc</td>
<td>5,591 seedlings</td>
<td>139,775</td>
<td>2,148 seedlings</td>
<td>53,700</td>
<td>38%</td>
</tr>
<tr>
<td>Tissue Cultured Banana plantlets</td>
<td>Php5/pc</td>
<td>5,691 plantlets in laboratory</td>
<td>28,455</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>807,254</strong></td>
<td><strong>220,814</strong></td>
<td><strong>27.4%</strong></td>
<td></td>
</tr>
</tbody>
</table>

As a result of the AFNR student-internship program, the more popular products with very limited supply (i.e., coco sugar) are now produced by AFNR students and sold directly to interested buyers and in the grocery sections of Shopping Centers in Zamboanga City. Coco sugar is readily saleable in retail direct to consumers while seaweeds is sold normally to dried seaweeds traders in Zamboanga City. Budded rubber seedlings, on the other hand, are sold to buyers who own rubber plantations in Zamboanga del Norte and Zamboanga Sibugay provinces because it is observed that more farmers are shifting to rubber as a result of higher prices of rubber latex. Tissue cultured banana seedlings are sold direct to plantation owners and the Department of Agriculture as part of its program on the distribution of banana seedlings to farmers in the region. Rubber and tissue cultured banana seedlings are similarly sold to “walk-in” buyers especially local farmers and businessmen who frequently visit the SUCs in search of planting materials for their respective farms.
Objective #2. To increase enrollment in AFNR courses by improving the employability of AFNR graduates through technical and managerial internship in agri-based enterprises with high S&T content.

While the “WMSU-AFNR EIGP-Student Internship Program on Entrepreneurship with High S&T Content (AFNR Project 3.1)” project is a DOST-PCARRD-led intervention to enhance the AFNR curriculum and improve enrollment in AFNR courses in Region IX, the project cannot claim that it is the sole factor that contributed to the 3 percent increase in the enrollment in the three SUCs that implemented AFNR Project 3.1. Among the many factors that contributed to the increase in enrollment from School Year 2007-2008 to School Year 2010-2011, it is safe to assume that the project is one of the factors that helped contribute to the increase in AFNR enrollment in the three SUCs (Western Mindanao State University, Zamboanga State College of Marine Sciences and Technology and Jose Rizal Memorial State University-Tampilisan Campus). WMSU registered the largest increase (+66 percent) in the number of AFNR students among the three implementing SUCs while JRMSU-Tampilisan has the largest decline in the number of AFNR students (-33 percent) as shown in Table 4.

Table 4
Trend in AFNR Enrollment in Region IX (Year 2008-2011)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>WMSU</td>
<td>196</td>
<td>222</td>
<td>240</td>
<td>305</td>
<td>+66</td>
</tr>
<tr>
<td>ZSCMST</td>
<td>387</td>
<td>390</td>
<td>391</td>
<td>372</td>
<td>-5</td>
</tr>
<tr>
<td>JRMSU-T</td>
<td>272</td>
<td>228</td>
<td>170</td>
<td>147</td>
<td>-36</td>
</tr>
<tr>
<td>Total</td>
<td>1,055</td>
<td>802</td>
<td>801</td>
<td>824</td>
<td>+3</td>
</tr>
</tbody>
</table>

Overall, the total number of AFNR students in the three SUCs declined by 64 percent from School Year 2000-2001 (2,293 students) to School Year 2010-2011 (824 students). The +32 percent increase in the enrollment in AFNR courses in ZSCMST could not cover up for the decline in the total enrollment in other SUCs. The declining trend reveals that the decline in enrollment in the AFNR courses will continue unless the Philippine government is able to find a solution to this problem. While the AFNR is an excellent initial step to reverse this trend, there could be other factors which have more significant impact and had greatly contributed to this problem.

Objective #3. To use the Project as a site and a showcase (demo farm) for the hands-on learning experiences in terms of application and testing of technologies and improve technical know-how and entrepreneurial abilities of AFNR students and unemployed graduates as well as develop the local production, processing and entrepreneurship/income-generating capability of the SUCs in the ZamPen region.
AFNR Project 3.1 has enabled the SUCs to enhance their curriculums through the integration of S&T with entrepreneurship in the AFNR undergraduate internship program and laboratory exercises across various AFNR undergraduate degree programs offered by the three SUCs in the ZamPen region. This curriculum enhancement project was fully aligned with the Regional Development Plan for ZamPen focusing on the value added dimensions and improvement in processing as well as S&T applications in the four champion commodities (coconut, seaweeds, rubber and banana) and the largest sources of livelihood income for farmers in the region.

The project sites serve as training venues for the hands-on and practical exercises of the training programs of different government agencies and non-government organizations whose programs focus on the enhancement of livelihood income, income-generating capabilities and improvement of agri-based socio-economic conditions of various clientele of the universities. During implementation, the project sites have provided the venue, raw material inputs, technology, business dimensions and the guidance of trained faculty members who devoted their time and efforts for the enhancement of the knowledge and skills of the AFNR student-interns and made them ready to face the employment and challenges prior to their graduation. Moreover, the internship in AFNR Project 3.1, they have acquired the necessary technical skills needed by the agriculture-based industries in the region.

Coco Sugar Student’s Enterprise

Science and technology application in the processing of fresh coconut sap into coco sugar is a new technology developed by the Philippine Coconut Authority-Zamboanga Research Center (PCA-ZRC). The immersion of AFNR student-interns in all aspects and processes involved in the production of coco sugar has improved their skills and technical knowhow on making use of available coconut trees in their respective communities and making alternative and financially viable livelihood from coco sugar. Together with entrepreneurial trainings, the interns were able to identify prospective buyers and make analysis of actual and real financial records.

Production of Tissue Cultured Banana Plantlets and Seedlings

The tissue culture of banana is a form of biotechnology which allows the mass production of planting materials under laboratory conditions. At the tissue culture laboratory of the Western Mindanao State University-College of Agriculture located in San Ramon, Zamboanga City, technical skills for the production of tissue cultured banana plantlets, which were grown into saleable seedlings, were learned by the interns through the project. However, the high aseptic requirements for the tissue culture processes inside the laboratory cannot permit its replication under backyard or household conditions. However, they can opt to buy the plantlets from the laboratory and grow these into seedlings under normal environmental conditions at the household or backyard level. Plantlets which can be bought from the tissue culture laboratory can now be grown to seedling stage in the backyard and then sold at a higher price. Thus, this can provide a viable livelihood for AFNR graduates and their families.

Budwood Garden and Budded Rubber Seedlings

The AFNR interns for rubber were not surprised by AFNR because most of their laboratory classes have rubber production contents. Besides, most of their AFNR students come from families who
own a certain number of hectares of rubber plantations located in the different parts of the three provinces in the region. Some students are already well-versed in budding as their parents had already shown them all the processes involved in the production of rubber seedlings and had also accompanied their parents in selling rubber seedlings and harvesting latex from rubber trees. The AFNR Project 3.1 rubber component clearly enhanced what most of the students are already familiar with and added a new dimension into marketing and financial management skills to BS Agriculture students.

**Student’s Deep Sea Seaweeds Production Enterprise**

Many Muslim students of the Zamboanga State College of Marine Sciences and Technology (ZSCMST) were sent to the college by their parents through the income derived from seaweeds farming. Course contents of their existing AFNR curriculums also have seaweeds production and processing contents. The infusion of additional resources from AFNR Project 3.1 provided additional inputs for the expansion of their existing production capacity while providing actual and practical exposure to their AFNR students in the S&T application for deep sea seaweeds farming, processing and selling. While dried seaweeds is relatively easy to sell because of the presence of numerous traders and seaweeds processing plants in Zamboanga City, the AFNR Project 3.1-Seaweeds component, nevertheless, had provided additional inputs and raw materials that increased the productive capacity of ZSCMST and the student-interns.

Overall, the outputs and accomplishments of AFNR Project 3.1 clearly improved the local manpower and institutional capabilities in S&T applications, entrepreneurship and income-generating capabilities and financial management of profit-oriented undertakings in coco sugar, tissue culture, rubber seedlings and seaweeds which can be used by the SUCs and their target clientele in the overall effort to improve the socio-economic conditions of farmers and fishermen in the ZamPen region. The project also developed the technical skills and entrepreneurial spirits of the AFNR interns and other students in the three largest State Universities and Colleges in the ZamPen region. Their practical and hands-on experiences in S&T applications via processing and production of the four different priority crops honed their technical skills, to a certain extent while actual marketing, negotiation and direct selling had developed their familiarity with business and entrepreneurial undertakings which are useful in the continuous effort for improvement of the socio-economic status.

### 7. FINANCIAL PERFORMANCE

While the entire project was able to produce different product lines with an estimated value of Php807,254.00, this represents only 21 percent of the total approved budget (Table 5). Actual sales for the 18-month period amounted to Php220,814.00 which represents only a much lower 6 percent of the total budget (DOST-GIA and SUCs counterpart). The financial analysis shows that the project did not attain it financial viability objective as a result of the subsidy given to the project in the form of honoraria for SUCs personnel assigned to the project as identified and approved by PCARRD. This subsidy increased the production and reduced the net profit for the project. It is recommended that computations on the actual financial statements should only include the honorarium of the Component/commodity Coordinator; not the project staff identified by PCARRD.
The sustainability plan for the four components capitalizes on the re-investment of sales (current and sales to be generated later when inventory will be sold) as new working capital for the succeeding cycles of project operations under the Income-Generating Projects/Corporate Units of WMSU, JRMSU-Tampilisan and ZSCMST. This modality helps ensure continuous project operations beyond the 18-month AFNR 3.1 duration. The DOST-GIA and SUCs counterpart funds will be recovered within five to six years of continued operations.
<table>
<thead>
<tr>
<th>Commodity/Component</th>
<th>Selling Price/Unit</th>
<th>Value of Goods Produced (PhP)</th>
<th>Total Sales (PhP)</th>
<th>Value of Inventory (PhP)</th>
<th>APPROVED BUDGET (PhP)</th>
<th>FINANCIAL PERFORMANCE INDICATORS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(A)</td>
<td>(B)</td>
<td>(C)</td>
<td>(D)</td>
<td>(E)</td>
<td>(F)</td>
</tr>
<tr>
<td>Coco Sugar, Jelly &amp; Honey</td>
<td>Php200/kg</td>
<td>180,974.00</td>
<td>98,624.00</td>
<td>82,350.00</td>
<td>642,078.30</td>
<td>273,780.00</td>
</tr>
<tr>
<td>Seaweeds</td>
<td>Php50/kg</td>
<td>8,050.00</td>
<td>3,450.00</td>
<td>4,600.00</td>
<td>382,079.38</td>
<td>244,080.00</td>
</tr>
<tr>
<td>Rubber Seedlings (for budding)</td>
<td>Php15/pc</td>
<td>450,000.00</td>
<td>65,040.00</td>
<td>384,960.00</td>
<td>679,882.51</td>
<td>483,300.00</td>
</tr>
<tr>
<td>Tissue Culture (Banana plantlets &amp; seedlings)</td>
<td>Php5 &amp; 25/pc</td>
<td>168,230.00</td>
<td>53,700.00</td>
<td>114,530.00</td>
<td>274,837.80</td>
<td>483,300.00</td>
</tr>
<tr>
<td>Administrative Support Services Honoraria</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>807,254.00</td>
<td>220,814.00</td>
<td>586,440.00</td>
<td></td>
<td>1,988,888</td>
<td>1,871,460</td>
</tr>
</tbody>
</table>

Cost-sharing Scheme (DOST-GIA versus ZamPen SUCs Counterpart Fund) 52% 48% 100%

Table 5
AFNR Project 3.1 Financial Performance by Component/Commodity
8. SUSTAINABILITY

While the income of the project did not match its targets and ideal financial ratios as a consequence of delays and other problems caused by government’s procurement system, accounting and auditing rules plus some institutional and administrative issues and challenges encountered during project implementation, said revenues generated from the sales of products produced by the project is sufficient to cover the budgetary requirements of the succeeding operations after December 2010. In sustaining the momentum of AFNR Project 3.1 in the three SUCs in the ZamPen region, pertinent activities will still continue for because resources generated from the project are sufficient to cover the cost of operations for at least three years after 2010. Furthermore the project’s activities were fully and comprehensively integrated into the four organizational mandates of WMSU, ZSCMST and JRMU-Tampilisan (e.g., instruction, research, extension and production/IGP).

8.a. Instruction

SUCs will continue the internships and laboratory exercises across the four commodities and improve the processes by which students will generate their own income from their internship especially for the (BS Agribusiness, DAT/BAT, BSA, BS Agricultural Engineering, BS Fisheries, BS Marine Biology and other AFNR students every school year.

- **Tissue Culture** - elective subjects for the Bachelor of Science in Agriculture, Bachelor of Science in Agribusiness, Bachelor of Agricultural Technology, Bachelor of Science in Forestry & Bachelor of Science in Agricultural Engineering.

- **Coco Sugar Production and Marketing** – elective subject for Bachelor of Science in Agribusiness, Bachelor of Science in Agriculture & Bachelor of Agricultural Technology. For the Bachelor of Science in Agricultural Engineering, this topic will be incorporated in the existing Agricultural Machine and mechanical Management subject for the design of appropriate mechanical equipment that will enhance production of coco sugar. Likewise, this technology will also be included in the existing Agricultural Entrepreneurship and Management subject for the production and marketing.

- **Rubber Budwood Nursery and Production** - elective subject for Bachelor of Science in Agriculture, Bachelor of Science in Agribusiness, Bachelor of Agricultural Technology.

- **Seaweeds Production** - elective subject for the BS Fisheries & Marine Biology

8.b. Research

Priority commodities under the AFNR program will be included in the Research and Development Agenda of the SUCs and in-house research funding will be lobbied and generated from R&D budget of the SUCs. The three SUCs will utilize the existing facilities in the proposed research activities from 2011 to 2016 as identified in the Regional Science & Technology Agenda for Region IX. Faculty and Students will be assigned to conduct research activities every year on the following related topics in collaboration with other WESMARRDEC and other Consortium agencies:
• Development and performance evaluation of new & improved crop varieties, forest trees suited under adverse conditions (extended flooding and drought, hot and humid conditions, saline soils)

• Participatory on-farm evaluation of improved varieties of coconut (source of coco sugar), rubber, seaweeds and tissue cultured banana, abaca and other crops suitable in the region

• Rapid multiplication & disease indexing of planting materials

• Processing of commodities into food items (product development, packaging, etc.), genetic improvement and disease control for rubber seedlings, banana and seaweeds and other food and alternative uses

• Identification of new market and supply chain management for agricultural commodities and processed food items from the region

8.c. Extension and Community Service

To implement the proposed extension program of the University trainings for tissue culture, coco sugar production, rubber budwood production and seaweeds production as well as concomitant improvement of livelihood options and activities via entrepreneurship trainings to be provided to different clients of the community and other farmers’ and fishermen’s groups based on the request of LGU, academe, other government and private agencies.

8.d. Production/Income-Generating Projects (IGP)

Production of the commodities previously under the AFNR project (coco sugar, banana tissue cultured seedlings, rubber budded seedlings and seaweeds) will continue with the budget coming from the Special Trust Fund of the SUCs. The entire project will be placed under the Income Generating Project/Corporate Units of the SUCs. Regular workers will be hired to do the various activities in production and to complement the activities and production of the student interns in succeeding production cycles every school year. Moreover, the income generated from AFNR 3.1 will be re-invested and used as working capital in the succeeding cycles beginning School Year 2011-2012 and every school year thereafter. By then, the continued project operations will become a little bit more business-and profit-oriented than during the implementation of AFNR Project 3.1.

In summary, DOST-PCARRD which made AFNR Project 3.1 a reality had provided an excellent momentum for the three ZamPen SUCs in enhancing their AFNR curriculums and institutional capacities for viable income-generating activities while utilizing science and technology in the production and operation processes and making business form the outputs of S&T application thereby improving the financial viability of the internship program in the three implementing SUCs in the region. Finally, the project enabled the enhancement of the technical know-how and the entrepreneurial spirits of the students thereby making them more preferred by the industry and had made them more confident and ready for the employment and livelihood options that they will choose and the career challenges that they will face after graduating from the university.
9. SUMMARY AND CONCLUSION

The project has immersed 362 AFNR student-interns from the three SUCs, which is 39 percent higher than the targeted number of student-interns within the 18-month period (May 2009-April 2010 and July-December 2010). The immersion had developed the technical and entrepreneurial skills of the interns that can match the requirements of the AFNR industries in the region which they can also use to start a financially viable livelihood or income-generating micro-enterprise in their respective communities should they opt for self-employment after graduation. Technical know-how acquired by the interns focused on application of Science and Technology in the processing of the flagship agricultural commodities of the region. On the other hand, entrepreneurial skills learned by the students boosted their confidence in making a financially rewarding livelihood from the products of S&T application in the four champion commodities of the region—coconut, rubber, seaweeds and banana. Coco sugar was produced from processing (S&T application) of fresh coconut sap; budded rubber seedlings were produced from rubber seeds and other planting materials; dried seaweeds was produced from deep sea seaweeds farming; and banana plantlets and seedlings were produced from tissue culture (a form of biotechnology). All products of S&T applications in the four commodities were sold and have ready market in the different provinces and cities of Zamboanga Peninsula.

Overall, the SUCs have provided a counterpart fund of Php1,871,460.00 or 45 percent of the total project cost of Php3,860,348.00 with DOST-GIA of Php1,988,888.00 or 55 percent of the total project cost. All SUC counterpart funds were spent on the honoraria of personnel involved in the implementation of the project while the DOST-GIA was spent entirely for supplies and materials used as working capital for project operations. The estimated value of the goods produced by the project amounted to Php807,254.00 with total sales amounting to Php220,814.00. The remainder of Php586,440.00 is tied up to the inventory of different product lines waiting to be sold at the right time and at the saleable stage:

- Coco Sugar—inventory is ready for sale in the next cycle.
- Dried Seaweeds—inventory is stored in the warehouse while waiting for the prices to go up so the project can make maximum sales.
- Rubber Seedlings—inventory are still in the nursery waiting for appropriate age of the crop when these can be budded and grown into to marketable budded seedlings
- Tissue Culture—tissue cultured banana plantlets are still in the laboratory until certain age when the plantlets can be transplanted and transferred to the nursery where they can be grown into seedlings and sold at the appropriate age.

Since the S&T application and entrepreneurship in the four commodities of AFNR Project 3.1 were already integrated in the different AFNR courses in the three SUCs, faculty members handling the concerned courses will now be required to regularly (every semester) include the AFNR commodities (S&T application and entrepreneurship) in the lecture and laboratory classes of AFNR courses. Actual and practical trainings will be financially supported by the funds generated from the sales of the processed and sold products. For School Year 2011-2012, sales from the operations will be used to finance the educational income-generating projects (e-IGP) of AFNR student-interns across curriculum and across the three participating SUCs in the region.
The project “Student Internship in Science and Technology-based Microenterprises in Zamboanga Peninsula, Philippines” provides an avenue for AFNR students to improve their skills in S&T-based processing of the four commodities into saleable consumer goods (coco sugar) and planting materials (rubber seedlings and tissue culture banana plantlets) and semi-processed export item (dried seaweeds) which are the main source of livelihood of farmers and fishermen in Zamboanga Peninsula, Philippines. While the project is a higher education curriculum intervention, its long-term positive impact to the region’s economic development is desirable across the four commodities, along regional development priorities and thru micro-entrepreneurship, science and technology and human resource development.

10. PROBLEMS ENCOUNTERED

The project is able to overcome administrative bottlenecks and other problems encountered during implementation. While these problems caused delays, the project is able to continue operations and all deliverables are completed as scheduled in December 2010:

1. **Very slow government procurement procedures & accounting & auditing rules.**

The entire project operations followed the usual and labyrinthine government accounting and auditing rules as well as the traditional procurement procedures. These processes caused massive delays in the procurement of supplies and other raw materials needed by the project. The project was already started when the Philippine government enforced the pre-auditing procedures for all financial transactions in addition to the delays and errors caused by the processes followed by WMSU procurement system.

2. **Student-interns cannot cope up with targets which were based on full-time and wage-earning workers.**

It was observed that student-interns were much slower in the processing of commodities into saleable products as compared to experienced and full-time workers who could devote eight hours a day to processing and other activities of the project. With the series of administrative bottlenecks encountered by the project, it was agreed that given other factors hindering the accomplishments, outputs were adjusted and lowered based on actual production of student-interns because they still have other academic requirements to comply especially those who are preparing for graduation.

3. **Raw material supply problem.**

There are many environmental factors acting upon the required speed and volume of production targets: weather conditions and seasonality. For example, supply of coco toddy “tuba” becomes limited especially during the rainy season when collecting sap becomes difficult and drying of coco sugar became the main problems. Some farmers are not willing to convert their copra-producing coconut trees for purposes of coco sap production. Also, the typhoon season with strong winds and big waves caused serious problems to the growing of seaweeds and the procurement of seaweed planting materials. Moreover, availability of planting materials especially rubber seeds is seasonal, which is available only in October and November. All the planting materials could not be stored for more than a month because
either they grow too old as planting materials or they die in early stages of growth or even before being transplanted to the field.

4. Delayed trainings (Pre-requisite for immersion) under Project 2 resulted in low production outputs as a consequence of shortened duration for the immersion.

While AFNR Project 3.1 has tried to get through WMSU’s administrative labyrinth, Project 2 trainings for the four commodities had its own administrative and procurement problems much more serious than those faced by Project 3.1. The procurement problems of Project 2 had caused a series of delays in the conduct of trainings as the pre-requisites for internship. Internship should have been started in the second week of June for the First Semester and First week of November for the Second Semester, delayed trainings under Project 2 delayed the start of the internship farther in August and January respectively. The only remedy was the adjustment of interns’ outputs based on available time because the project cannot force the students to continue the internship since they always go home during semestral and summer breaks. On the other hand, other students prioritize their compliance with graduation requirements especially within the month of March because graduation ceremonies are normally conducted within the fourth week of March every school year.

11. RECOMMENDATIONS

1. All heads of offices involved in project operations be included in the workshop prior to the start of project operations focusing on how they can help expedite the slow procurement and accounting and auditing procedures.

2. Adjustment in the production targets based on prevailing procurement, accounting and auditing as well as environmental factors impinging upon the attainment of production targets with consequences on the project’s financial performance.

3. Profit-oriented projects should be channeled through the employees association or cooperatives where procurement processes can be expedited to adequately respond to the required speed in transaction processing that are more business-friendly; not just mere compliance with stringent rules and regulations which have been proven to be slow, complicated and un-friendly to any business initiative under governmental conditions.

4. The project should be placed under the Agribusiness or Income-Generating Projects or Corporate units of the SUCs.

5. Project income should be placed under a Special Trust Fund and be re-invested as working capital in the succeeding operations especially beyond the duration of the AFNR Project 3.1.
REFERENCES


