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Enhancing the Demand for AFNR Graduates through S&T: A National Program Boosting Agri-Aqua based Entrepreneurship among the Youth in the Philippines

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INTRODUCTION

The importance of AFNR graduates in the Philippines

The Philippines, like the rest of the developing world, experienced accelerated industrialization and urbanization in recent decades. Worldwide, the demographic transition process and globalization of labor and trade have been pervasive. Despite these developments, the rural population remains large and the dependence of the country on its primary sectors: agriculture, forestry, fisheries and other natural resources (AFNR) is hardly diminished. Traditionally the source of raw materials on which the whole economy depends, there are many new roles to fill and ever-growing challenges faced by the AFNR sector in the national effort towards food and energy self-sufficiency, increased regional and international trade and sustainable development.

Agriculture, forestry and fisheries are still the major sectors of employment and income generation in the Philippines. About one-third of the total land area of the country is devoted to agricultural production, including aquaculture. Agriculture in 2007 accounted for 20% of GNP and 24% of total exports earnings while the value of fish production from 1981-2003 yielded an annual growth rate of 10.28%. Combined, the AFNR sector remains the biggest direct and indirect employer of Philippine labor, accounting for 46% of total employment in the 15 years period 1992-2007 (BAS, 2008) leading up to the program.

The continued importance of the AFNR sector in the country implies the need for a steady supply of competent human resources (professionals, practitioners and entrepreneurs) that will not only sustain current productivity requirements of the country but will also push for further development into new and advanced fields related to AFNR (e.g. the science, technology and engineering-related fields). According to UNESCO (2007), at least 380 R&D scientists and engineers per million are needed to fast-track development. The Philippines had only 157 per million population. To aggravate the situation, more and more AFNR graduates were going abroad to seek greener pastures. Thus, maintaining a critical mass of quality AFNR graduates in the country was an urgent concern.

The Philippines has over a hundred State Universities and Colleges (SUCs) offering courses and degree programs in agriculture, forestry and fisheries. These SUCs produce AFNR graduates who work in government service, private companies and agro-forest-based industries. There is

no shortage of public or private Higher Education Institutions (HEIs) although the number of SUCs or "Public HEIs" offering AFNR and Allied Science degree programs far exceeds the number of "Private HEIs" offering similar degree programs.

However, in the decade 1998-2007, the enrollment of students in AFNR courses at SUCs drastically declined, threatening the future supply of professional agriculturists, foresters and fisheries experts, field practitioners and skilled farm, forest and fishery workers needed to sustain the productivity and development in these vital sectors of the Philippine economy.

In an annual survey conducted to determine the preferred post-secondary degree programs of high school graduates- Agriculture, Fisheries and Forestry was at Rank 5 in SY 2000-2001. This went down to Rank 10 in SY 2007-2008 and by the current SY 2008-2009, Agriculture, Fisheries and Forestry was not even in the top 20 most preferred degree programs. While fewer incoming freshmen are now choosing AFNR courses, reflecting a declining demand, there is an increasing preference for those related to health (nursing), business, computer and education programs.

Addressing a serious national concern

By 2007, the human resource situation confronting the country in the AFNR was a complex problem with no simple and "single-best" solution. Addressing this problem requires strong political will and concerted efforts from the private and public sectors to support and promote AFNR higher education. Any meaningful solution also necessitated the direct and active involvement of the country's SUCs, the country's public HEIs offering AFNR degree programs.

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In a meeting with the Philippine Association of State Universities and Colleges (PASUC) in December 2007, President Gloria M. Arroyo recognized the urgency of the situation and committed her support to alleviating the problem. She personally instructed the DOST Secretary and PASUC Presidents to come up with a proposal to curb the trend of declining enrollment in AFNR courses.

The then Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), packaged the proposal with the backing of PASUC, the Commission on Higher Education (CHED), and it was approved at the Department of Science and Technology (DOST) by February 2008. PCARRD mobilized its National Agriculture and Resources Research and Development Network and 14 regional R&D Consortia largely based in the SUCs. PCARRD managed the program in cooperation with other DOST units, i.e. the Philippine Council for Aquatic and Marine Research and Development (PCAMRD), Technology Application and Promotion Institute (TAPI), DOST Regional Offices and other organizations working for AFNR and human capital development in the country.

Thus from 2008 to 2011, human capital build-up in the agriculture, forestry, and natural resources (AFNR) received a major "boost" through this P235-million national program on increasing the demand for AFNR professionals and entrepreneurs.

The national program entitled *"Enhancing the Demand for AFNR Graduates through Science and Technology",* aimed to provide direct interventions to state universities and colleges (SUCs) to improve the quality of degree programs and increase enrolment in AFNR courses and allied fields. One of its more important objectives is to provide support to entrepreneurship development and employment generation in selected SUCs so that agriculture, forestry and fisheries graduates will have viable alternative options to the traditional employment route. While most AFNR graduates are generally well trained for jobs in government service, the private sector and the academe, the same cannot be said for the entrepreneurship route, which directly promotes self-employment and the development of new agriculture, forestry, fisheries and food-based industries, but has not received as much attention in the past. Through the hastening of transfer and commercialization of SUC-developed technologies, AFNR graduates have the chance to start their own agri-businesses and even become potential employers themselves.

PROGRAM COMPONENTS

The national program implemented three inter-related components. The first component involved survey research and policy analyses to understand the factors causing the downtrend in enrolment in AFNR courses and to forecast future supply of and demand for AFNR graduates.

Component 1-type projects were led at the national level by the Philippine Institute of Development Studies (PIDS), the University of the Philippines Diliman-National College of Public Administration and Governance (UP-NCPAG), and the University of the Philippines Los Baños (UPLB). PIDS was the over-all coordinator while UP-NCPAG managed Project 1.1 Policy Research on the State and Future Supply of and Demand for AFNR Graduates in the Philippines; and UPLB led Project 1.2 Forecasting Supply and Demand of AFNR Human Resources in the Philippines. Project 1.1 activities were carried out by 28 implementing SUCs, 2 SUCs per region. Project 1.2 which was implemented by the UPLB College of Economics and Management (CEM) and Institute of Statistics (INSTAT), built on the results of the Inventory of AFNR In-School and Graduate Tracer Survey but also included a business establishment survey and time-space modeling of AFNR human resources in the Philippines. Project 1 activities were completed in November 2009.

The second component focused on institutional capacity enhancement in key SUCs from the major island groups. The strategies under this component included facilities enhancement, equipment procurement, curriculum review and development and short-term training for students, graduates and faculty. Facilities enhancements were deemed vital to attract more enrollees, provide better learning environments and give students and graduates more opportunities to gain practical experiences in entrepreneurship outside the regular classroom. Faculty trainings, study tours and re-tooling were conducted to strengthen the ability of AFNR mentors to teach students relevant and updated materials and prepare them for business alternatives to employment after graduation. Curriculums related to agribusiness and entrepreneurship were developed and enriched to help students acquire more practicable skills for setting up and managing agri-aqua based ventures with high S&T content.

The third component, which is the main focus of this paper, builds on components 1 and 2 and provided funding support to the development and establishment of various modalities which were viable agri-based business employers and could serve as on-the-job training venues for AFNR students and graduates to enhance their skills in entrepreneurship, and to apply and test their AFNR technical know-how. All projects supported were required to show financial viability, high S&T content, and real prospects of employment-generation for AFNR graduates.

Dubbed as "Support to Entrepreneurship Development and Income Generation in AFNR SUCs" Component Project 3 tested four (4) major modalities which served as the immersion venues for students and graduates to apply the technical and entrepreneurship knowledge they have gained from various trainings in Component Project 2. These are: [1] the *Educational Income Generating Projects* or *E-IGPs*; [2] the *Technopreneurial Learning Projects* or *TLPs*; [3] the *DOST-Academe Technology-Based Enterprise Development* or *DATBED-like Projects*; [4] the *Technology Business Incubation* or *TBI; and Magsasaka Siyentista (MS) Farms*.

Educational Income Generating Projects (E-IGPs) had the principal purpose of functioning as agri-business learning venues of students while at the same time income generating activities for the universities. SUCs in the Philippines are required to have at least 50 hectares of land before they can offer a BS Degree in Agriculture. This land was deemed necessary for effective conduct of teaching-learning activities, agricultural, aquatic and forestry research, field demonstrations, extension and production. Hence there was a lot of land that could be put to productive use by producing agri-aqua goods and services from available technologies. Prior to the program, many universities already operated income generating agricultural production projects known as IGPs. The E-IGP modality was a modification to allow the direct involvement of AFNR students in the different stages of production and management and experience earning income from agri-aqua business enterprises.

The ***Technopreneurial Learning Project (TLP)*** was developed as the second modality with the same purpose as the E-IGP and therefore shared other similarities. However, compared to the E-IGP which is technical "expert-led" and managed to allow students to participate in various operations, a TLP is "student-led" and managed but with mentoring, and close monitoring from a faculty or technical expert from the university. Also, the TLP is operated by the student "off-

campus" in his/her own production/enterprise area while the E-IGP is located within university premises or "on-campus". Lastly, since E-IGPs were university-funded, their scale of operations were generally bigger and accommodated more students than the TLPs, which were supported by student or family funds and grants from various sources. Where TLPs utilized program funds, the zero-cost financing principle applied but recovered

The ***DATBED*** is a program implemented by the Technology Adoption and Promotion Institute (TAPI) of DOST. It is an interest-free, non-collateralized micro-lending facility provided by TAPI to accredited SUCs through DOST Regional Offices to in-school and out-of-school youth to primarily finance the working capital requirements of proposed agribusiness enterprises. It has a set of lending requirements- like an approved Business Plan, with the faculty serving as the guarantors of loans, among others. PCARRD adopted this program as an entrepreneurship immersion modality to be tested in three regions- Southern Tagalog, Bicol and Eastern Visayas. The loan character of the DATBED, the faculty guarantee system and parents' commitments to repay the loan are what differentiate it from E-IGPs and TLPs. About 118 enterprises were approved and funded under this modality with Bicol having the highest number of funded enterprises.

Component Project 3 provided the enabling environment for the first practice of entrepreneurship through immersion in E-IGPs, TLPs, DATBED-Like Projects and TBI Start-ups. The immersion of students, graduates and other clients also came in various modes and names such as: On-The-job-Training, Practicum, Field/Farm Practice, NSTP, Plant Practice, Student Internship Program (SIP), Occupational Internship Program (OIP), while others made their Thesis or Special Problem from their exposure to the various agribusiness projects.

Some implementers designed their immersion strategy to include the fourth modality called the ***Maqsasaka Siyentista (MS) Farm***s. The MS or farmer-scientists were PCAARRD's partners and models in the dissemination and adoption of superior AFNR technologies in various farming communities nationwide. MS are progressive, market-oriented farmers who are keen on adopting S&T interventions. PCARRD supported them with new technologies to demonstrate side by side their own best practice in a Science and Technology-based farm (STBF) set-up. Their success and methods was shared with 15-30 other farmers in the community through annual Farmer Field Days. In Bicol, this was an additional immersion done to augment their students' in-campus immersion experiences with the actual business operations of established agri-aqua enterprises.

The ***Technology Business Incubation (TBI)*** was designed to be the natural progression of students and graduates who are serious in the pursuit of their entrepreneurship careers and have chosen business enterprises after their training and immersion experiences with E-IGPs, TLPs and DATBED-like projects. The main objective of the TBI is to nurture would-be start-ups until they become more independent free-standing enterprises. The TBI itself however, was also a start-up, and had also to prove itself to be a viable techno-transfer and commercialization modality. Three TBIs were either established or supported in the program: at CLSU, VSU and UPLB.

END-OF-PROGRAM PHYSICAL ACCOMPLISHMENTS BY COMPONENT

Component Project 1.

Component Project 1 was a pioneering socio-economic research because never before has there been a more systematic and comprehensive tracer study for AFNR courses covering all 14 regions of the country. From 2008-2009 "Policy research on the state and future supply of and demand for AFNR graduates in the Philippines" tracer studies were conducted for 95 out of the total 111 higher education institutions (HEIs) nationwide. Project 1 completed 19,098 in-school student surveys, 9,469 graduate tracer surveys, and over 2,500 employers' surveys. From the regional and national AFNR human resource data collected, models for explaining and forecasting the supply of and demand for AFNR human resources were developed.

The student and tracer surveys revealed the sentiments, aspirations and prospects of AFNR graduates, including the trend that less than 5% get self-employed, engage in business. Policy analyses and recommendations were disseminated through print media, 12 regional and 5 National Dissemination Conferences attended by government line agencies, League of Provinces of the Philippines, League of Cities of the Philippines and state universities and colleges (SUCs).

Component Project 2.

Component Project 2 became the biggest direct investment of DOST to AFNR-SUCs' institutional capacity building since the eighties (1980s). Under the 2nd Component, 149 AFNR facilities were enhanced and 3,847 learning, laboratory, processing and field equipment items were procured across 45 SUC beneficiaries. Under curricular enhancements, 118 AFNR curricula were reviewed, 85 curricula enriched, 29 curricula revised, 17 new curricula developed. There were 1,701 learning materials developed in support of curricular enhancement comprising of 187 technical and entrepreneurship training manuals, 178 course syllabi, 120 training modules, 225 business plans, 38 laboratory and lecture manuals, and 562 other learning materials (such as cases, technical bulletins, short courses, investment packages, leaflets, flyers, AV presentations, etc.). AFNR degree programs were also enhanced through the review of 36 courses/subjects, enrichment of 25 subjects/courses, and development of 3 new subjects.

Throughout the duration of the program, 294 trainings were conducted for 17,283 clients composed of 10,847 AFNR students, 1,897 graduates, and 3,577 other clients. On faculty retooling, 85 trainings were conducted for 1,486 faculty: 201 in technical trainings, 440 in entrepreneurship trainings, 183 in combined entrepreneurship and technical trainings, 611 in other trainings, and 179 in study tours. Twenty-five (25) project staff were also trained alongside faculty members. In addition, Component 2 supported 23 projects that enhanced the R&D efforts of 16 partners in 9 regions, which contributed to the generation of 96 new technologies and 1 extension modalities.

Component Project 3:

Entrepreneurship and employment generating S&T-based AFNR development programs of selected HEIs, was the largest component of the program accounting for 65% of total program funds and 75% of total project activities, all of which combined to highlight the important role of entrepreneurship and employment generation in attaining the objectives of the program. Two hundred thirty-six (236) Component 3 projects were spread over 14 regions and 54 SUCs across the country. Project 3 included the establishment and operation of SUC-based techno-demo activities in crops, livestock, forestry and fisheries and student training and immersion in 83 Educational Income Generating Projects (E-IGPs), 32 Technopreneurial Learning Projects (TLPs), and 118 DOST-Academe Technology-Based Enterprise Development (DATBED)-like projects. In addition, 2 Technology Business Incubators (TBIs) were established and operationalized at Central Luzon State University (CLSU) and Visayas State University which nurtured 6 Start-ups. The accomplishments for the third component include the immersion of 6,978 students, 1,062 graduates, and 235 other clients- mostly youth (in high school and out-of-school). Component 3 also contributed to the transfer and commercialization of 96 technologies, the development of 236 new agri-based enterprises (MSEs) and the employment of 1,198 AFNR students/graduates.

IMPACT ASSESSMENT OF ENTREPRENEURSHIP DEVELOPMENT COMPONENT IN AFNR SUCS

By design, the AFNR program interventions related to entrepreneurship were intended to be institutionalized at the SUC project sites in order to sustain the gains of the program. In 2017, the program was subjected to Impact Assessment. This section summarizes the evaluation results for Component 3 which highlight S&T based entrepreneurial agri-aqua projects financial performance during the implementation of the AFNR program and after its completion.

The benefit-cost analysis (BCA) was used for E-IGPs and TLPs sustained after the AFNR Program. BCA was done per commodity or type of enterprise for each region. Net benefits were discounted to get net present value (NPV) using 6% discount rate. Internal rate of return and benefit-cost ratios (BCR) were also computed. The benefits comprised of the total annual gross sales from the project while the costs included the investments in the AFNR program and the SUC and the operating costs after the project, which were estimated using the market-based approach. Due to limitation in financial data on equipment and facilities, depreciation costs were not included as part of the costs in the cash flow analysis. For projects that stopped immediately

or a year after the AFNR program, return on investment (ROI) was computed to analyze the net returns in relation to the project total investment.

Among all the E-IGPs and TLPs, the banana production and enterprise model (BPEM) of USEP was the only project that showed positive cash flows from 2011 to 2016 and thus, a positive NPV amounting to PhP 187,317. It has an IRR of 9% and a BCR of 1.08. These values imply that BPEM was worth pursuing and financially sustainable.

The supply chain approach taken in USEP's projects played a key role in the economic viability of BBPEM. With the sustainability of its banana tissue culture and nursery enterprise, USEP's banana production has a stable and reliable supply of quality planting materials which enabled the expansion of its production. The quality bananas produced were also sold at competitive prices. Lastly, the vermicompost ancillary enterprise also provided the organic fertilizer needed by the banana plantation.

It is worth mentioning that the viability of USEP's BPEM can also be attributed to the technical and business competence of it project leader because most project leaders in other SUCs were technical experts but had little or no business orientation. Hence, many of their E-IGPs and TLPs did not survive after the AFNR program ended.

The other E-IGPs and TLPs that were able to sustain their operations up to present – include JRMSU's rubber production, CLSU's rice production, VSU's goat production and UPLB's cheese and rennet enterprises. But while these SUCs continued to generate returns every year from their entrepreneurial projects, in many cases, annual costs still exceeded the financial benefits, mainly because of personnel, overhead costs and other factors.

For JRMSC, sales of rubber seedlings did well since 2010 but there has been a constantly declining inventory of rubber seedlings after the AFNR program due to shifting preference for fruit trees. For the VSU goat enterprise, the stock inventory more than tripled as a result of improved goat housing and proper management although sales barely expanded after the program completed.

For the TLPs, UPLB's cream cheese and rennet TLPs showed a substantial increase in its total revenues from 2009/2010 to 2016. A key success factor for the expanded sales of both technology products was market security through institutional buyers. Furthermore, there is a strong value chain relationship inherent because rennet is a critical base ingredient of cheese.

As for DATBED-like enterprises, the projects in Bicol were the most successful overall, and reached a combined net income of PhP 269,452 with an ROI of 11%. For the Southern Tagalog and Eastern Visayas Regions, majority of the DATBED projects were discontinued after the AFNR program at the SUCs but DOST Regional Offices still fund DATBED.

Finally, for the BCA analysis of the TBI at CLSU, the NPV and IRR were both negative from 2011-2014 but the net return became positive from 2015 onwards. The VSU TBI has since moved forward in its operations hosting 2 additional incubates from 2013-2015. Meanwhile, BSU established its own TBI after the AFNR program and since 2017 it has led the Agri-Aqua TBI Program of PCAARRD with 10 new SUC-based TBIs across the country.

Despite the not so positive results of the financial analysis of the original E-IGP, TLP, DATBED-like and TBI projects, it can still be said that the investment of PCAARRD-DOST on the AFNR projects has paid off considering the significant positive impact to the institutions, faculty, and other student-participants. For one, most participating SUCs experienced an increase in the enrolment in the AFNR degree programs. While these are difficult to translate into monetary terms, it can be definitely said that the AFNR projects resulted to positive outcomes.

Moreover, participating SUCs that experienced increases in the enrolment in the AFNR degree programs, also enjoyed increases in passing rates in licensure exams of their graduates, and institutional and program accreditation from TESDA and AACUP. The other institutional impact include having functional and presentable laboratories and being able to demonstrate some processes which was not possible without the needed equipment, facility and animals. There were also the personal impact to the professors in terms of the pedagogical skills they gained, some awards, and their being encouraged to also engage in entrepreneurship. Moreover, the student participants also benefited a lot in terms of entrepreneurial competencies gained, increased career choices and the opportunity to network with start-up financiers and other people who can help them with their business. Lastly, it was noted that almost all the TBIs were strengthening their technology patenting and commercialization initiatives of the output of R&D.

It was recommended that there is a need to strengthen the link among component Projects 2 and 3 and that future AFNR projects should level up and focus on value-adding integrated enterprises. In particular, technologies developed under PCAARRD-funded researches can be considered for commercialization by SUC E-IGPs, TLPs, DOST DATBED beneficiaries and other students establishing start-ups in agri-food TBIs.

SUMMARY AND CONCLUSIONS

During the decade spanning 1998-2007, the Philippines experienced a rapid decline in enrollment in agriculture, forestry, fisheries and natural resources related (AFNR) degree programs, which caused serious threats to the human resource pool in these critical sectors of the economy. The three-year national program launched in 2008 addressed the urgent need to systematically take stock of the current state and future capacity of human capital in the AFNR sectors, provide direct interventions to capacitate state colleges and universities (SUCs) and enhance the employability and entrepreneurial opportunities of AFNR graduates in the Philippines. This is the single biggest funded Human Resource Development program for this sector. The program however has many more distinctions worth noting.

It is the only one of its kind to provide a complete package of research, development, extension, commercialization and institutional capacity building components in one program. Having AFNR researchers, farmers and agri-business stakeholders as its mainstream clients, it is the first time PCAARRD directly addressed the curricular, employment, and entrepreneurial needs of AFNR faculty, students and graduates. This program involved the most number of implementing and partner agencies across the country, totaling 124 over 3 years. It is also the first joint program undertaken between PCAARRD and PCAMRD addressing the full range of AFNR and aquatic sectors previously undertaken separately by the two councils, which consolidated in 2011 as PCAARRD.

Five years after completion, an impact assessment study was conducted for the program. The overall financial analysis result shows an overall NPV of Php 98,933,208 and an overall IRR of 22%. These indicators apply to the E-IGPs and TLPs that continued after the program ended. On the other hand, for the projects where only ROIs were derived, the overall ROI was 87% and the average BCR was 0.13. This indicates that the TLPs and E-IGPs except for the banana production and enterprise model (BPEM) were mediocre investments from a normal business perspective.

Based on financial records, majority of the costs of each project were comprised of capital expenditure for facilities improvement and equipment procurement. For the SUCs, this significantly boosted their capacity to operate a business as well as to have a venue for students and other stakeholders for instruction, research, and entrepreneurial training. Most of the benefits derived from the TLPs and E-IGPs cannot be monetized. Hence the overall reported benefits of the individual projects, and the program are understated.

After three years of implementation and 5 years institutionalization, the AFNR program on entrepreneurship development yielded some significant successes, many works-in-progress and quite a few setbacks as well. The most important successes attained were the: [1] strengthening of the entrepreneurship orientation of various AFNR curricula and students; [2] transfer of mature technology to students and graduates; [3] establishment of new Agri-Aqua-based enterprises and facilities; [4] increased employment opportunities of AFNR graduates; and [5] enhanced Academe-Public-Private Partnerships for agri-business development.

LIST OF ACRONYMS

BSU	Benguet State University
BU	Bicol University
CLSU	Central Luzon State University
CVSU	Cavite State University
JRMSU	Jose Rizal Memorial State University
USEP	University of Southeastern Philippines
VSU	Visayas State University

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