

Background Paper No. 5
Current Situation and Future Opportunities in Agricultural
Education, Research and Extension in Myanmar¹

by

Khin Mar Cho

July 2013



¹ This background paper was commissioned as part of a Strategic Agricultural Sector and Food Security Diagnostic for Myanmar, led by Michigan State University and in partnership with the Myanmar Development Resource Institute - Centre for Economic and Social Development (MDRI-CESD).

Background Paper No.5
**Current Situation and Future Opportunities in Agricultural Education,
Research, and Extension in Myanmar**

by

Khin Mar Cho

July 2013

Khin Mar Cho is senior extension associate, coordinator, MarketMaker and Food Hubs Programs, director, International Programs, International Agriculture, Food and Nutrition Specialist.

This study was made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of Michigan State University and the Myanmar Development Resource Institute do not necessarily reflect the views of USAID or the United States Government.

EXECUTIVE SUMMARY

Myanmar is an agricultural based country and the agriculture sector is the backbone of its economy. The agriculture sector contributes 34% of Gross Domestic Product (GDP), 23% of total export earnings, and employs 63% of the labour force. About 75% of the total population reside in rural areas and are principally employed in the agriculture, livestock, and fishery sectors for their livelihood.

Rice is the most important dominating crop and is grown in saline area mostly found in lower Myanmar especially in Ayeyarwady, Yangon, Tanintharyi Regions, also in Yakhine, and Mon States. Deep-water rice is usually grown in areas of some restricted belts in Ayeyarwady, Bago, Tanintharyi Regions, and Rakhine, Mon, and Kayin States. Out of the total crop sown area of 10 million hectares, about 13% is under irrigation. The rest of the land has to rely on the rain for crop production.

The population will grow to about 60 million by the year 2013 and the demand for local rice consumption alone, will be in the proximate of 20 millions tons. To be able to supply enough food for the increasing population and export the surplus, rice production will have to be increased up to 25 million tons, by expanding the rice growing area up to 6 million hectare. This scheme will further be enhanced by the adoption of modern proven technologies and provision of the required inputs in full.

The Ministry of Agriculture and Irrigation is making all-out efforts for the development of agriculture, taking measures as: efficient utilization of land and water resources; farm mechanization; introduction of new technologies; and supply of farm inputs. Agriculture being the largest economy of the country, the Ministry tries to stimulate public awareness and interest for better participation and investment in the sector.

The government of the Union of Myanmar remains committed to the contribution of national as well as world food security. The agriculture sector in Myanmar occupies a dominant position in the development of the national economy, and has a definite bearing on other socio-economic activities. Because of the high potential of land, water resources, man power resources, and other mineral resources, Myanmar has been prominent as an agricultural country for many years and will continue to be so in the future.

Given the importance of agriculture in Myanmar, agricultural education, research, and extension are important priorities. In the process of developing the agricultural sector, conducting training and offering educational programs of international standard are crucial to the development of human resources.

CONTENTS

EXECUTIVE SUMMARY	iii
LIST OF TABLES	vi
LIST OF FIGURES	vi
ACRONYMS	vii
1. Agricultural Education.....	1
1.1. State Agricultural Institutes.....	1
1.2. Yezin Agricultural University.....	2
1.2.1. Organization of Yezin Agricultural University	3
1.2.2. Academic Departments.....	3
1.2.3. Campuses of Yezin Agricultural University.....	3
1.2.4. Selection and Admission to YAU.....	4
1.2.5. Curriculum and Degrees Offered at YAU	4
1.2.6. Students and Academic Staff in 2011-2012 Academic Year.....	6
1.2.7. International Collaboration	7
1.3. Strengths and Opportunities	7
1.4. Areas Needing Improvement.....	8
1.5. Needs of Technical Assistance.....	8
1.5.1. Review of YAU Different Curricula and Identify New Curricular Areas/programs	8
1.5.2. Develop an Agro Ecosystem-based Curriculum and Research Program at YAU	8
1.5.3. Review of the Organization, Management and Governance System of the University.....	9
1.5.4. Review of Academic Procedure and Administration in the University.....	9
1.5.5. Develop Strategy and Approaches to Strengthen the Research Function of the University.....	9
1.5.6. Develop Ideas on Utilization of the Seven Sub-campus of YAU	9
1.5.7. Establish an Outreach Campus in Ayeyarwady Region	9
2. Agricultural Research	10
2.1. Organization of DAR	10
2.2. Agricultural Research Centers and Satellite Farms.....	11
2.3. Research Activities Conducted by DAR.....	12
2.3.1. Some Research Activities Conducted by DAR Are as Follows	12
3. Agricultural Extension.....	14
3.1. Agricultural Extension Organization.....	14
3.2. Agricultural Extension Approaches, Methods, and Strategies.....	16
3.3. Agricultural Extension of Myanmar Agriculture Service under the State Peace and Development Council Government.....	18
3.4. Agricultural Knowledge, Information, and Technology.....	22

3.5. Training Options for Extension Professionals.....	23
3.5.1. Central Agricultural Research and Training Centre	24
3.5.2. Central Agricultural Research Institute (Now DAR).....	25
3.5.3. Myanmar Academy of Agriculture, Forestry, Livestock, and Fishery Sciences	25
3.6. Information and Communication Technology for Agricultural Extension	27
3.7. Institutional Linkages for Pluralistic Agricultural Extension System	28
3.8. Process of Reform Extension Strategies	31
3.8.1. Reform Areas in Agriculture Sector Development (Policy Statement from the Ministry of Agriculture, Myanmar).....	32
3.9. Extension for Food Security in Myanmar	32
3.9.1. The Role of Extension	32
3.9.2. Points to Consider	33
3.9.3. A Pluralistic Extension Network	33
3.9.4. Focus on Development of Human and Social Capital	34
3.10. To Re-Emphasize	34
3.10.1. Extension Alone Cannot Do It.....	34
3.10.2. The Key Is an Integrated Approach.....	34
References.....	35

LIST OF TABLES

TABLE	PAGE
1. Curriculum and Degrees Offered at YAU.....	5
2. Student Statistics of Yezin Agricultural University (2011-12).....	5
3. Distribution of Undergraduate Students at YAU (2011-12).....	6
4. Academic Qualifications of YAU Staff (2011-12 Academic Year).....	6
5. Crop Research Centers and Satellite Farms under DAR.....	11
6. Satellite Farms and their Mandate Crops.....	11
7. Number of Public Extension Staff in Agriculture, Forestry, Fishery, and Rural Development in Myanmar as of 2009.....	16
8. Academic Qualifications and Gender of Human Resources in Agricultural Extension in Myanmar as in 2010-2011.....	16
9. Yearly Budget Allocation to MAS and Agricultural Extension Service Kyats Million.....	20
10. Budget Allocation and Expenditure at MAS, as of 2009-2010 Budget Year, Kyats Million.....	20
11. Extent of Training in Technical Disciplines Received by Extension Agents in Myanmar during the Period 1995-2000.....	26
12. Overseas Training Received by Extension Agents of Myanmar during the Period 1995-2000.....	26
13. Perceptions of Extension Agents on Factors Affecting the Performance of Extension Activities.....	29

LIST OF FIGURES

FIGURE	PAGE
1. Linkage between Yezin Agricultural University and State Agricultural Institutes.....	2
2. Organization of Yezin Agricultural University.....	3
3. Campuses of Yezin Agricultural University.....	4
4. Organizational Structure of Ministry of Agriculture and Irrigation.....	15
5. Organizational Structure of Myanmar Agriculture Service.....	19
6. The Proposed Institutional Model for the Implementation of a Participatory Extension Approach in Myanmar.....	30
7. Organizational Structure of the Proposed Forum for Participatory Extension Movement..	31

ACRONYMS

ACIAR	Australian Centre for International Agricultural Research
AED	Agricultural Extension Division
AKIT	Agricultural Knowledge, Information and Technology
AMSC	Agricultural Management and Supervision Committee
ARI	Agricultural Research Institute
AVRDC	World Vegetable Center
CARI	Central Agricultural Research Institute
CARTC	Central Agricultural Research and Training Centre
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
DAR	Department of Agricultural Research
DOA	Department of Agriculture
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
IAEA-MYA/5016	International Atomic Energy Agency (IAEA)
IARI	India Agricultural Research Institute
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	Information and Communication Technology
IITA	International Institute for Tropical Agriculture
IRRI	International Rice Research Institute
JICA	Japan International Cooperation Agency
KOICA	Korean International Cooperation Agency
LBVD	The Livestock Breeding and Veterinary Department
MAS	Myanmar Agriculture Service
MCSE	Myanmar Cotton and Sericulture Enterprise
MDRI/CESD	Myanmar Development Resource Institute - Centre for Economic and Social Development
MOAI	Ministry of Agriculture and Irrigation
MOEC	Ministry of Environmental Conservation
MOF	Ministry of Forestry
MOLF	Ministry of Livestock and Fisheries
MPCE	Myanmar Perennial Crops Enterprise
MSE	Myanmar Sugarcane Enterprise
NIAST	National Institute of Agricultural Sciences and Technology (South Korea Rural Development Administration)
NRCT	National Research Council of Thailand
RDA	Rural Development Administration (Korea)
SAI	State Agricultural Institutes
T&V	Training and Visit
TICA	Thailand Incentive and Convention Association
UOF	University of Forestry
USAID	United States Agency for International Development
UVS	University of Veterinary Science
YAU	Yezin Agricultural University

1. AGRICULTURAL EDUCATION

The agricultural education system in Myanmar includes three universities, all under different ministries and focused on different segments of the agricultural sector. The Yezin Agricultural University (YAU), under the Ministry of Agriculture and Irrigation (MOAI), covers crop sciences and in addition offers some courses in animal sciences and fisheries. YAU also operates seven regional research stations where it deploys students to conduct research during their final year. The University of Veterinary Science (UVS), also in Yezin but under Ministry of Livestock and Fisheries (MOLF), covers veterinary sciences and fisheries but not crop agriculture. The University of Forestry (UOF) under the Ministry of Environmental Conservation (MOEC) specializes in issues of land management, environment, and forestry. In addition to these degree-conferring institutions, seven State Agricultural Institutes (SAI) under the MOAI offer the agricultural education diploma program for high school graduates.

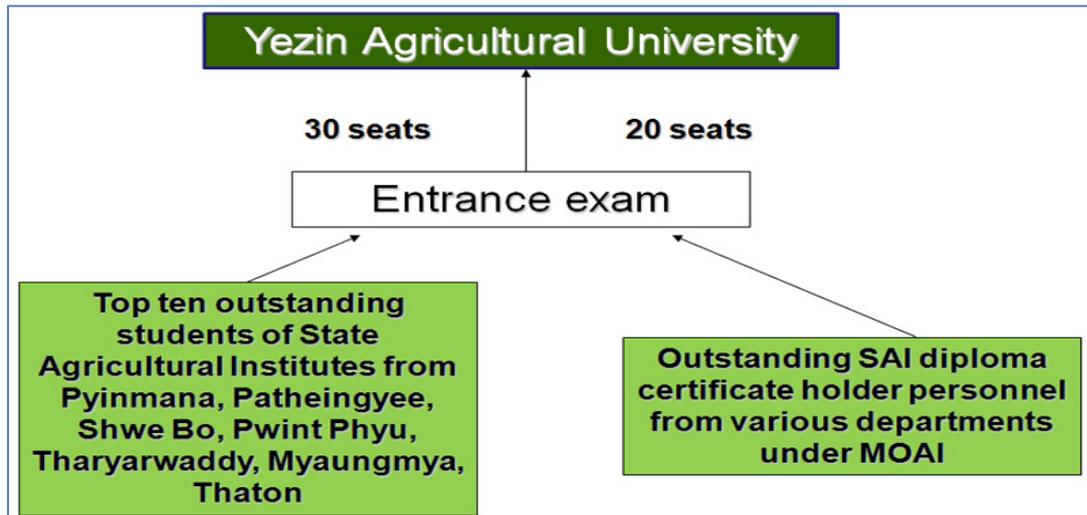
1.1. State Agricultural Institutes

The agricultural education training at the State Agriculture Institutes was started in 1955 in Myanmar. There are seven agricultural institutes in Myanmar, such as Pyinmana SAI, Thahtone SAI, Myaungmya SAI, Shwebo SAI, Patheingyi SAI, Pwintphyu SAI, and Tharyarwady SAI. The annual intake for the first year students is about 200 for each institute and the total numbers of students for these seven Institutes is about 1500. The required period of study is only three years. For the first year study English, Mathematics, Physics, Agricultural Chemistry, Botany, Agronomy, Horticulture and Animal Husbandry courses are introduced. Plant Protection and Farm Mechanics subjects are added to the courses for the second year. In the third year, the courses follow eight major subjects, such as Agronomy, Agricultural Chemistry, Horticulture, Animal Husbandry, Plant protection, Farm Mechanics, Agricultural Extension and Farm Management and Accounting (Cho 2003).

Students gain a Diploma in Agriculture after they completed three-year studies. The top ten outstanding students can join the third year study of undergraduate program at YAU for pursuing a Bachelor of Agricultural Science Degree if they pass the entrance examination. Starting from 1966, there has also been a golden opportunity for outstanding students from SAI and service personnel holding diploma certificate of the SAI across the country to join YAU and continue their academic destiny. However, only 30 seats for outstanding students and 20 seats for outstanding service personnel per year are available (Figure 1).

The number of students that graduate annually from different educational training institutions includes 300 from YAU and 1500 from seven SAI. Many of the graduates from YAU and SAI are employed by different departments of the MOAI.

Figure 1. Linkage between Yezin Agricultural University and State Agricultural Institutes



Source: The author. Adapted from YAU PowerPoint presentation 2012.

1.2. Yezin Agricultural University

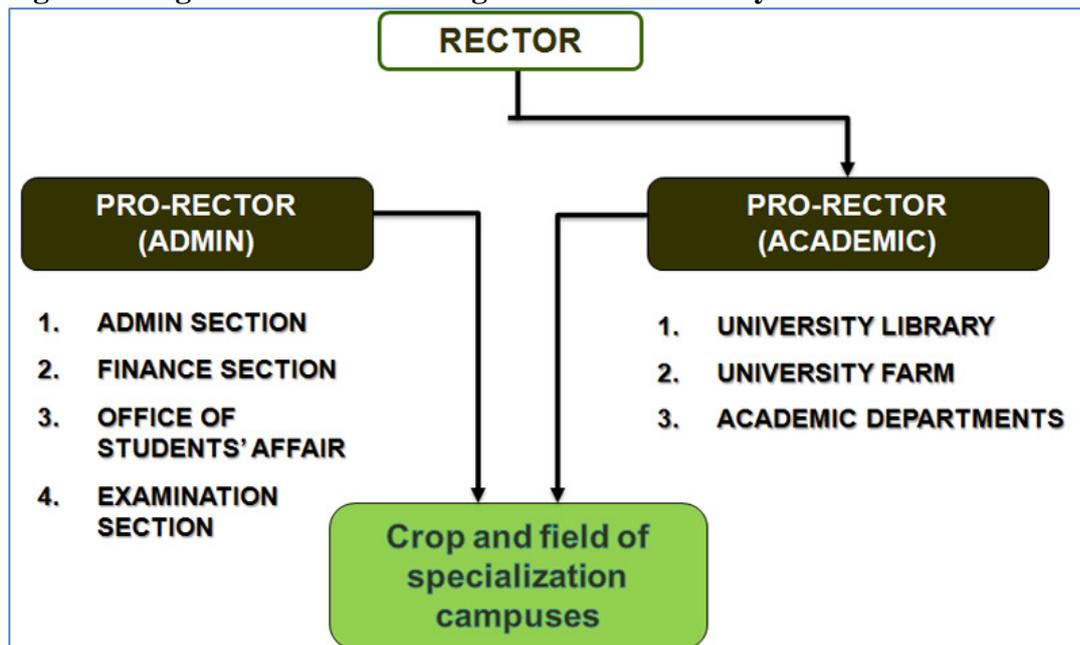
Yezin Agricultural University is the principal agricultural agency of higher education in Myanmar, and most agricultural scientists at the government agencies graduated from this university. It is located about 11 miles north of Pyinmana in the new capital Nay Pyi Taw, and has a farm which has access to irrigation.

The YAU is a well-established university with its glorious past since its establishment in 1924 in Mandalay. On 22nd of December in 1924, Governor Sir Spencer Harcourt Butler inaugurated the Burma Agricultural College and Research Institute which offered a three year Agricultural Diploma program. Before being set as a separate institute under Ministry of Education as Institute of Agriculture in 1964, it was just a faculty under Rangoon and Mandalay Universities alternately. In 1973 the campus was relocated from Mandalay to the present location due to geolocation and suitability of crop production; five years after this move, a Master Degree course was started. In 1993, the management was transferred from Ministry of Education to Ministry of Agriculture and Irrigation for better facilities. It was renamed Yezin Agricultural University in 1998. Two years after its Diamond Jubilee celebration in 1999, the university opened the Ph.D. course as its highest curriculum. YAU had been shaped by many directors since its establishment in 1924.

The goal of the university is to educate students to enable them to attain a high standard in agricultural sciences, and generate well qualified agriculturists for the country. The university has nine departments of basic and applied agricultural sciences, and offers both B.Sc. and M.Sc. degrees in agricultural sciences. Recently, the university has started a Ph.D. program in which the faculty is experienced and well-qualified. Some of the teaching staff has received post-graduate training overseas.

The three missions of the university are to provide education and develop human resources for increased production through green growth, to provide career and business opportunities for the graduates who are well qualified, and to contribute to the nation through research and education.

Figure 2. Organization of Yezin Agricultural University



Source: The author. Adapted from YAU PowerPoint presentation 2012.

1.2.1. Organization of Yezin Agricultural University

Under the administration of the rector, the university affairs are assisted by two pro-rectors of academic body and administrative body (Figure 2). There are seven major academic departments and six supporting subject departments.

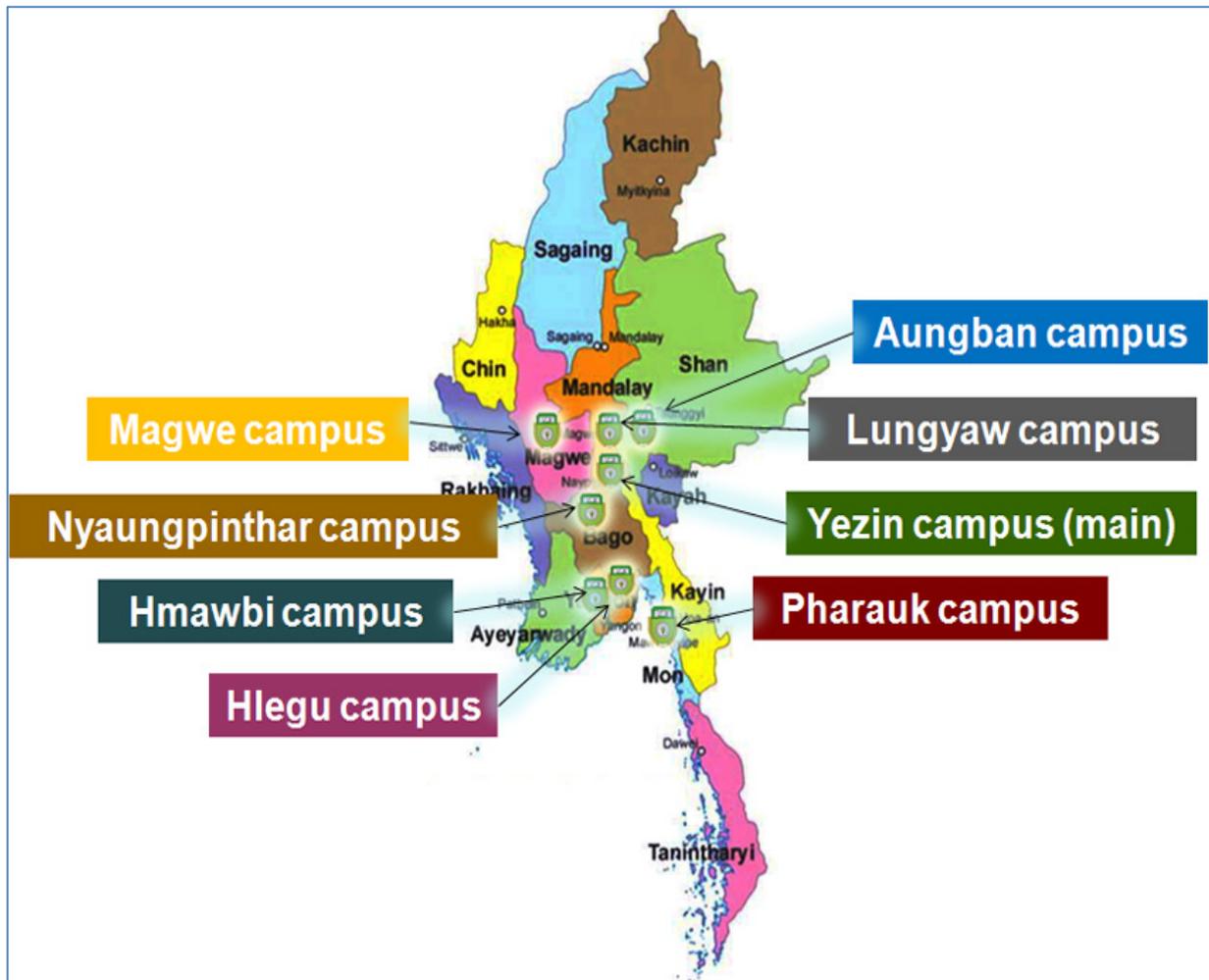
1.2.2. Academic Departments

- | | |
|---|---|
| 1. Department of Agronomy | 8. Department of Animal Science |
| 2. Department of Agricultural Botany | 9. Department of Agricultural Engineering |
| 3. Department of Agricultural Chemistry | 10. Department of Myanmar |
| 4. Department of Plant Pathology | 11. Department of English |
| 5. Department of Entomology and Zoology | 12. Department of Physics |
| 6. Department of Horticulture | 13. Department of Mathematics |
| 7. Department of Agricultural Economics | |

1.2.3. Campuses of Yezin Agricultural University

In 2006, the university curriculum was modified and improved and with it, seven new campuses around the country were established for final year students' research and specialization studies. Therefore, nowadays, YAU has seven outreach campuses nationwide (Figure 3). Aungban campus in Shan state for maize and other cereal crops, Lungyaw campus in Mandalay for, cotton and other fiber crops, Pharauk campus for perennial crops, Hlegu campus for Plant Protection and horticultural crops, Hmawbi campus for rice crop, Nyaungpinthar campus for sugar crops, Magwe campus for oilseed crops, and the main campus in Yezin for agribusiness management and soil and water management. Here in the main campus, the emergence of biotechnology specialization is anticipated.

Figure 3. Campuses of Yezin Agricultural University



Source: The author. Adapted from YAU PowerPoint presentation 2012.

1.2.4. Selection and Admission to YAU

Normally to be admitted in YAU, the students are required to pass Basic Education High School with good scores and physical and mental fitness. Moreover, a good character record is a must. First year undergraduate students are selected by the University Board of Education through entrance examination and annually 400 students are admitted to the university.

All admissions are determined by entrance exam composed of two parts: 1) written examination: Biology subject for 3 hours and English subject for 2 hours, and 2) personal interview. The university follows bi semester system where first semester falls in November through March and second semester, May through September.

1.2.5. Curriculum and Degrees Offered at YAU

As its curriculum, Yezin Agricultural University offers five degree programs (Table 1) and the medium of instruction is English. See Table 2 for the number of students in each program and Table 3 for the number of undergraduate students and where they are from.

Table 1. Curriculum and Degrees Offered at YAU

Curriculum	Period	Study Programs
Bachelor Degree (B.Agr.Sc.)	4 Years	11
Master Degree (M.Agr.Sc.)	3 Years	7
Master of Philosophy Degree (M.Phil.)	2 Years	7
Doctorate Degree (Ph.D.)	5 Years	7
Post Grad Diploma (Dip. Agr.Sc.)	0.5 Year	7

Source: YAU 2012.

Bachelor Degree in Agricultural Sciences (B.Agr.Sc.). Yezin Agricultural University offers undergraduate programs in the following specialization areas:

- | | |
|-----------------------------------|---|
| 1. Rice crop production | production |
| 2. Plant protection | 7. Oil seed crops production |
| 3. Horticultural crops production | 8. Cotton and other industrial crops production |
| 4. Plantation crops production | production |
| 5. Sugar crops production | 9. Agribusiness management |
| 6. Maize and other cereal crops | 10. Soil and water management |

Postgraduate Degrees (M.Agr.Sc.: Ph.D.: M.Phil.): Masters degree in Agricultural Sciences, Ph.D. and Master of Philosophy degrees are offered in Yezin Agricultural University and specializations are in field crop production, crop science, soil and water management, plant disease protection and plant pest protection, horticultural crop production, and agri-business management.

Postgraduate Diplomas in Agricultural Sciences (Dip.Agr.Sc.): Postgraduate Diploma course is another opportunity of studying at YAU and specializations are Agronomy, Agricultural Botany, Agricultural Chemistry, Plant Pathology, Entomology, Horticulture, and Agricultural Economics.

Table 2. Student Statistics of Yezin Agricultural University (2011-12)

Course	Male	Female	Total	Remarks
First year	227	249	476	
Second year	204	278	482	
Third year	166	267	433	
Final year	138	244	382	Field of specialization
M. Phil.	1	-	1	
M. Agr.Sc.	23	130	153	
Ph.D.	4	8	12	
Total	763	1,176	1,939	

Source: YAU 2012.

Table 3. Distribution of Undergraduate Students at YAU (2011-12)

Region	Male	Female	Total
Naypyitaw	136	260	396
Kachin	7	7	14
Kayah	8	9	17
Kayin	8	8	16
Chin	17	5	22
Sagaing	144	146	290
Tannintharyi		1	1
Bago	36	60	96
Magwe	112	131	243
Mandalay	136	226	362
Mon	24	40	64
Rakhaing	10	7	17
Yangon	18	33	51
Shan	66	90	156
Ayeyarwaddy	7	12	19
Total	729	1,035	1,764

Source: YAU 2012.

1.2.6. Students and Academic Staff in 2011-2012 Academic Year

Regardless of inadequacy in materials and poor infrastructures, the university is proud to possess such well qualified academic staff for teaching and research (Table 4.). At YAU, 42% of the teaching staff are those who got their master and doctorate degree from abroad. Some faculty members attended overseas training in nutrition and food science technology and biotechnology.

Although the department of agricultural extension education does not yet exist at YAU, some faculty from the department of agronomy provide extension education courses to undergraduate students as well as conduct extension research activities.

Table 4. Academic Qualifications of YAU Staff (2011-12 Academic Year)

Qualification	Staff
Ph.D.	34
M.Sc./M.Agr.Sc./M.V.Sc.	38
M.A./M.Sc. (Basic Science)	25
B.Agr.Sc./B.Sc./B.A./B.V.Sc./B.C.Sc.	86
B.E./A.G.T.I.	4
M.Com	1
Total	188

* Gender Ratio of Academic Staff (Male: Female) 1:3.5

Source: YAU 2012.

The following are some of agricultural extension and agricultural economics research activities conducted by YAU in 2011-2012:

A. Completed Master Students' Theses in 2011-2012 (1st Semester)

- Market Integration Approach to Natural Rubber Market Development,
- Ex-Post Evaluation of Rice Research and Extension Expenditures of the Ministry of Agriculture and Irrigation,
- Impact Assessment of Thonze Dam on Socio-Economic Status of Paddy Farmers in Tharyarwady Township,
- Food Security Status of Rural Households in Man Man Sai township, Wa Special Region No.2, Northern Shan State, and
- Assessment of Sustainability in Rain-fed Cropping System of Natmouk Township.

B. On-Going Theses in Second Semester, 2012 (2nd Semester)

- Technical Efficiency of Sesame Production in Magway Township,
- Impact of Climate Change on Rural Livelihoods in Pakokku Township,
- Impact of Farm Mechanization on Crop Productivity in Pyinmana Township,
- Factors Affecting the Demand for Agrochemicals in Nay Pyi Taw,
- Comparison of Different Types of Extension Services on Rice Productivity in Pyay,
- Analysis of Rice Supply Chain in Waw Township, and
- Impact Assessment of Microfinance on Climate Change Resilience and Livelihood Security of Rural Households in Pakokku.

1.2.7. International Collaboration

Regarding Faculty Capacity building and Faculty skill development, YAU has long been working with the international organizations and institutions and still collaborates with many international universities and institutes. Presently, YAU has been in active international collaboration with Korean International Cooperation Agency (KOICA), India Agricultural Research Institute (IARI), and Japan International Cooperation Agency (JICA):

- Library automation software system cooperated by KOICA
- Establishment of Advanced Center for Agricultural Research and Education in collaboration with IARI, India
- Strengthening human development institution in Agriculture sponsored by JICA

1.3. Strengths and Opportunities

Compared to other universities YAU has lots of strengths and opportunities and plays a vital role in many areas of Agriculture Sector Development in Myanmar.

- Presence of a visionary, dynamic, energetic leadership who is getting broad support from the faculty and staff.
- High interest on the part of the Ministry of Agriculture, its sponsor and link in the cabinet, in collaborating with YAU particularly in manpower training and development, seed production, technology testing, extension and advisory service.
- Existence of critical number of highly trained faculty members from foreign universities (35 Ph.D. and 65 Master Degree holders).
- Although needing much upgrading and improvement, there exists classrooms, laboratories, research farms and stations, scientific equipment, housing for faculty,

- students and guests, and free WiFi on the campus.
- Existence of land and stations for university's field research, practicum for students, and physical expansion.

1.4. Areas Needing Improvement

1. General review of the B.S., M.S. and Ph.D. curricula, Develop an agro ecosystem-based curriculum and research program
2. Improvement and completion of the University strategic plan including the departmental strategic plans.
3. Continuing and expanded staff development program for new program offerings.
4. Need to review and rethink the seven sub-campuses as facilities for instruction, research, practicum, and extension.
5. Need to create department of Agricultural Extension Education, conduct collaborative research with the Department of Agricultural Research (DAR) and the Department of Agriculture (DOA) and provide the University direct extension service to rural farmers like e-Agriculture Information Center
6. New campus layout, paved on-campus road system, student extra-curricular activities and pro-student welfare facilities, IT-ready and connection facilities, staff housing, to mention some, need modernization.
7. Academic administration including university governance and organization for higher effectiveness and efficiency need streamlining.
8. Adjustment in pedagogy in the teaching of courses, considering large class size, limited number of faculty, limited space and equipment for use in instruction need to be done.
9. Process, structure, and content of university research agenda and programming need to be clarified and defined.
10. The collection, system, and facilities of the university library need to be updated.

1.5. Needs of Technical Assistance

1.5.1. Review of YAU Different Curricula and Identify New Curricular Areas/programs

(Agricultural Extension Education, Agribusiness, Food Science/Nutrition Science, Biotechnology, Information and Communication Technology- ICT, etc.).

A more specific and focused study and analysis of YAU is its curricula at the BS, MS and Ph.D. levels. A curricular review is essential because a curriculum is the recipe of the university in producing graduates. The curriculum is the translation of the vision, mission and core values into program of studies, courses, academic and non-academic inputs, requirements and the total learning experiences of the students while under the tutelage of the university.

1.5.2. Develop an Agro Ecosystem-based Curriculum and Research Program at YAU

This is to be done in partnership with U.S. universities, and Asian agricultural universities. To make the university an inclusive and unifying force to facilitate national unity and ease ethnic tensions, an agro ecosystem-based curriculum and research program should be developed at the university, drawing on indigenous knowledge.

1.5.3. Review of the Organization, Management and Governance System of the University

The organization, management and governance of an institution of higher learning is a system of hierarchy. It provides the structure, and the players are involved in making decisions, planning, problem solving, and communication. It programs the regular procedure in dealing with emerging issues presented for resolution. The issues can be curricular, faculty and staff welfare and conduct, infrastructural, budget allocation, staff development, etc.

1.5.4. Review of Academic Procedure and Administration in the University

This would include time from admission to graduation. There are set of rules, procedures, and reviews at various levels as the students move from admission to graduation in a university. This is done to insure order and quality of the guidance and supervision of the students so that the product is according to design.

1.5.5. Develop Strategy and Approaches to Strengthen the Research Function of the University

YAU is not only an academic system of instructing students, imparting to them classical and practical know how and do how in production, processing of products, making decisions, problem solving agricultural problems. YAU is also mandated as a research arm of the country through the Ministry of Agriculture so that cutting edge technologies and innovations can be generated to spur growth and development in the sector. The U.S. Universities technical assistance can help structure the university's research function so that it can respond and be proactive in research for the country.

1.5.6. Develop Ideas on Utilization of the Seven Sub-campuses of YAU

The seven sub-campuses of YAU are vital assets that can be used to aid and realize the university goals in instruction, research and extension. The activities at the stations should be driven by the needs of instruction, research and extension programs of the university and relevant to the concerns and reforms of the Ministry of Agriculture. The technical assistance should include how the assets and resources can be positioned to serve the interest of the university including using them to generate income for the university.

1.5.7. Establish an Outreach Campus in Ayeyarwady Region

Since Ayeyarwady region is well known as the rice bowl of the country, one of YAU's outreach campuses should be established in this region. Presently, there are two outreach campuses in Yangon region. According to the current student distribution at YAU, there are very few students from Ayeyarwady region who study at YAU (See Table 3). It is very important to train youth for future agriculture sector development in Myanmar. High school and middle school students need to be motivated to study agricultural and food sciences for future development of agriculture and food security in Myanmar.

2. AGRICULTURAL RESEARCH

Given the importance of agriculture in Myanmar, agricultural research and development is an important priority. Agricultural research in Myanmar is overseen by three separate entities: the Ministry of Agriculture and Irrigation (MOAI), the Ministry of Forestry (MOF), and the Ministry of Livestock and Fisheries (MOLF). The Department of Agricultural Research (DAR), under MOAI, is the principal government agency involved in agricultural research and development. In 2003, DAR accounted for about 40 percent of the country's agricultural research staff and 30 percent of its expenditures (Stads and Kam 2007).

The DAR is headquartered in Yezin, about 250 miles north of Yangon. Agricultural Research Institute (ARI) was initially established at Gyogon, Insein township, Yangon in 1954. ARI was then shifted to Yezin, Pynmana Township, Mandalay Division (now Nay Pyi Taw) in 1971. It became Central Agricultural Research Institute (CARI) under the Myanmar Agriculture Service (MAS) and then DAR became as a separate department in 2004.

The mission of DAR is to systematically conduct research activities that would suit to the needs of all stakeholders, which include producers, distributors and consumers in developing, and dissemination of regionally adapted crop varieties and crop production technologies. DAR's research focuses on increasing crop production through improved seed, crop management, and crop protection techniques; and cropping systems tailored to suit the country's various agro-ecological zones.

The Forest Research Institute under MOF, is headquartered in Yezin and operates units on forest utilization and forest development. The Livestock Breeding and Veterinary Department (LBVD) under MOLF is responsible for the development of Myanmar's livestock sector. It conducts research on biological production, veterinary medicine, artificial insemination, and reproductive disorders. In addition, it produces vaccines and provides extension services to farmers. LBVD is headquartered in Yangon and operates four laboratories which are in Mandalay, Basein, Taunggyi, and Pyin Oo Lwin.

2.1. Organization of DAR

Under the administration of a director general, DAR is organized by two deputy director generals, six directors, eight deputy directors and over 700 staff including research officers, research assistants, research technicians and others across the country.

There are six major divisions under DAR and each division is composed of 2-4 sections.

1. Rice and other cereal crops division
 - a. Rice section
 - b. Other Cereal Crops section
2. Oil seed crops and food legumes division
 - a. Oil Seed Crops section
 - b. Food Legumes section
3. Industrial crops and horticulture division
 - a. Industrial Crops section
 - b. Horticulture section
4. Soil, Water Utilization and Agricultural Engineering division
 - a. Soil Science section
 - b. Water Utilization Research section

- c. Agricultural Engineering section
- 5. Agronomy, Agricultural Economics and Statistics division
 - a. Agronomy section
 - b. Agricultural Economics section
 - c. Statistics section
- 6. Biotechnology, Plant Genetic Resources and Plant Protection division
 - a. Biotechnology
 - b. Plant Genetics Resources section
 - c. Entomology section
 - d. Plant Pathology section

2.2. Agricultural Research Centers and Satellite Farms

Table 5. Crop Research Centers and Satellite Farms under DAR

State/Region	Crop Research Center (7)	Satellite Farm (17)
Kachin State	-	1
Kayah State	-	1
Sagaing Region	-	2
Taningthari Region	-	1
Mon State	-	1
Mandalay Region	2	5
Magway Region	2	-
Bago Region	1	1
Shan State (South)	1	2
Shan State (North)	-	2
Shan State (East)	-	1
Ayeyarwaddy Region	1	-

Source: DAR 2012.

Table 6. Satellite Farms and their Mandate Crops

Satellite Farms	Crops
Mohnyin	Rice
Pangon	Rice, wheat, chickpea
Zaloke	Rice, wheat, chickpea, pigeon pea
Kyaukse	Rice, chickpea, sunflower
Kyauktada	Rice, groundnut
Myingyan	Pigeon pea, green gram, sorghum
Tatkon	Maize, groundnut, sunflower, chickpea, green gram
Aungban	Upland rice, maize, wheat, soybean, niger
Kyaukme	Rice, maize
Loikaw	Rice, maize
Thegon	Rice
Taryaw	Rice, soybean, sunflower

Table 6 con't.

Naungmon	Rice, wheat, maize, soybean
Kyineton	Rice, maize
Sebin	Rice, maize, sunflower, green gram, pigeon pea
Dawae (7) miles	Pomelo, rambutan
Azin-2	Pomelo, rambutan, durian

Source: DAR 2012.

2.3. Research Activities Conducted by DAR

The DAR engages in substantial collaboration at national, regional, and international levels. Nationally, DAR conducts joint research projects with YAU and other departments like LBVD. The DAR engages in collaborative research with a number of centers of the Consultative Group on International Agricultural Research (CGIAR), including the International Rice Research Institute (IRRI), International Maize and Wheat Improvement Center (CIMMYT), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Bioversity International, and International Institute for Tropical Agriculture (IITA). Other international partners include the World Vegetable Center (AVRDC) and the International Atomic Energy Agency (IAEA).

2.3.1. Some Research Activities Conducted by DAR Are as Follows:

A. Crop Improvement

- Development of improved high yielding crop varieties for favorable ecosystem
- Development of rice and other food crop varieties with good yield stability under both biotic and abiotic stress conditions due to climate change and global warming
- Develop and promote food crop varieties with good quality
- Varietal Improvement:
 - Rice varieties released:
 - Irrigated rice (36 varieties)
 - Rain-fed lowland rice (34 varieties)
 - Upland rice (4)
 - Drought tolerance rice (8)
 - Deep water rice (8)
 - Submergence tolerant rice (1)
 - Salinity tolerant rice (4)
 - Quality rice (4)
 - Other varieties released:
 - Maize and other cereals (32 varieties)
 - Oil seed crops (19)
 - Food legumes (37)
 - Industrial crops (20)
 - Horticultural crops (4)

B. Crop Management

- Generate environmental friendly crop management technologies to fully capitalize the genetic potential of each genotype

- Identify and promote crop management options to reduce yield variability under stress conditions due to climate change
- Conservation and management of plant genetic resources for sustainable utilization

C. On-going Collaborative Projects with International and Regional Organizations

- Development of Iron Rich Rice through Nuclear Technique project (IAEA-MYA/5016)
- Increasing food security and farmers' livelihood through enhanced legumes cultivation in the central Dry Zone of Myanmar (ACIAR+ICRISAT)
- Agriculture technology development and promotion of corn (ICF)
- Korea-Myanmar collaborative agricultural research and development project (RDA)
- Biotechnology and plant genetic resources cooperation (NIAST)
- Thai-Myanmar soybean research and development project (NRCT+TICA)
- Consortium for unfavorable rice environment (IRRI)
- International network for genetic evaluation rice (IRRI)
- Irrigated rice research consortium (IRRI)
- Development study on sustainable agriculture and rural development for poverty reduction in the central Dry Zone (JICA)
- Agriculture extension human resource development project (JICA)
- Development of participatory multiplication and distribution system for quality rice seed (JICA)
- Capacity building and regional collaboration for enhancing the conservation and sustainable use of plant genetic resources in Asia (FAO/Japan)

The Vegetables and Fruit Research and Development Centre was established in 1986 by the cooperation of the governments of Japan and Myanmar research focusing on a variety of issues related to fruits and vegetables. The Applied Research Centre for Perennial Crops in Mawlamyaing was founded in 1990 within the Myanmar Perennial Crops Enterprise (MPCE), under MOAI. The center conducts research on variety improvement and production technology of plantation crops (mainly oil palm and rubber). The Myanmar Cotton and Sericulture Enterprise (MCSE), under MOAI, was established in 1994. In addition to carrying out cotton and sericulture research, it provides extension services to farmers. The Myanmar Sugarcane Enterprise (MSE) was also established in 1994 under MOAI with the aim of integrating and developing sugarcane production and processing. According to the new administration of MOAI in 2012, these three agencies of MPCE, MCSE, and MSE are under the Department of Industrial Crops Development.

3. AGRICULTURAL EXTENSION

Agricultural extension service in Myanmar was started by the Department of Agriculture in 1927, that is, about 21 years before the country's independence. The extension service was responsible for providing educational activities, collection of statistical data, enforcement of standard weights and measures, procurement and distribution of improved seed, farm equipment, fertilizers and insecticides. The distribution of seed and the delivery of inputs were considered as extension's main activities. In 1976, the Training and Visit (T&V) system of extension was introduced under a World Bank financed project. However, the operations and resource persons could not be sustained after the end of the project. From 1979 to 1986, the Selected Concentrative Strategy, more or less similar to the T&V system, developed by the national staff was followed in a special production program focusing on high-yielding crops in irrigated areas. This strategy along with the T&V system continues till today.

3.1. Agricultural Extension Organization

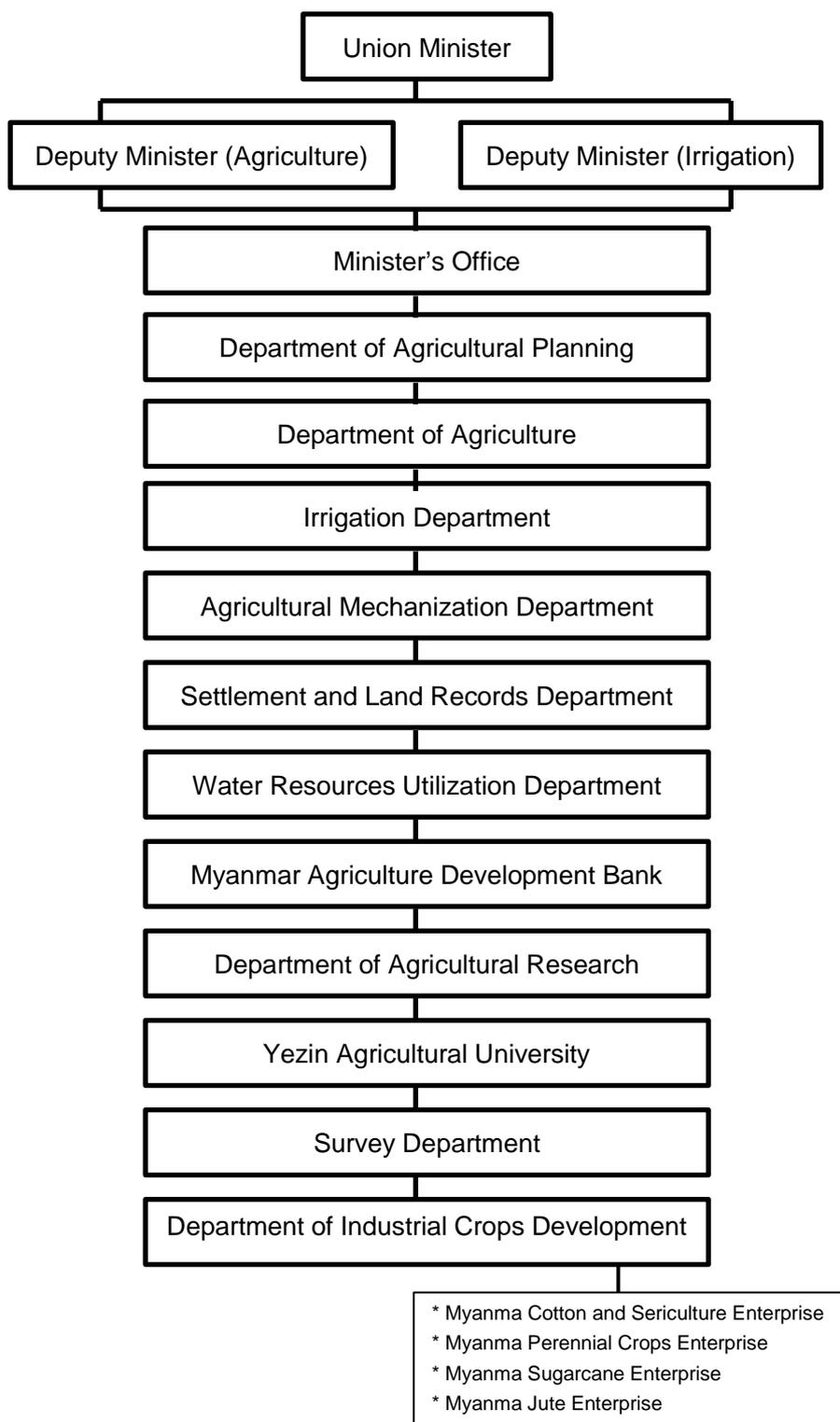
The Department of Agriculture (DOA), headed by a director general, is the sole government institution responsible for providing public extension services to the farmers. The DOA performs functions including extension towards the following objectives:

- The increased production of major crops;
- The development of improved production technology through proper research on management of soil crop and pest control;
- The development of suitable high-yielding crop varieties;
- The transfer of appropriate crop production technology through agricultural extension program;
- The distribution of certified seeds through the seed program;
- The provision of agricultural inputs;
- The classification of soils and advising on soil conservation techniques;
- The exploration of export markets on some agricultural produce.

The Department of Agriculture is one of 12 institutions of the Ministry of Agriculture and Irrigation (Figure 4.). It has eight divisions, the Agricultural Extension Division (AED) being the biggest. Recently, the AED has been undertaking the following extension activities:

- Training and capacity building of extension agents;
- Training of farmers in transfer of technology through Farmers Field Schools; Farmers to farmers discussion, training and education;
- Farmer-based participatory demonstration trials and field visits by local authorities and extension agents;
- Delivery of educational materials, pamphlets, newsletters and books on new crops;
- Education of farmers on the utilization of quality seed, drum seeder, combine harvester, dryers, etc.
- Explanation of post-production losses in rice production to the farmers;
- Cooperation among government, non-government and other relevant institutions for the dissemination of advanced technology at village level.

Figure 4. Organizational Structure of Ministry of Agriculture and Irrigation



Source: Adapted from MOAI 2012.

The staff hierarchy of the AED is multi-layered. Starting from the top, it includes: director general of DOA, deputy director general, director, assistant director, general manager (state/region), manager (district), assistant manager (township manager), deputy township manager, village tract manager, and village manager. Tables 7 and 8 outline the number of public extension workers in Myanmar.

Table 7. Number of Public Extension Staff in Agriculture, Forestry, Fishery, and Rural Development in Myanmar as of 2009

Discipline	Total Extension Staff	Female Extension Staff only	Support Staff
Agriculture (including crops and livestock)	5,631	2,574	1,760
Forestry		11	
Fishery (Marine and aquaculture)	20	5	30
Rural Development	5,296	2,384	1,678

Source: FAO Rome 2010.

Table 8. Academic Qualifications and Gender of Human Resources in Agricultural Extension in Myanmar as in 2010-2011

Staff Categories	Secondary School Diploma		2-3 Year Agricultural Diploma		B.Sc. Degree		M.Sc. Degree		Ph.D.	
	F	M	F	M	F	M	F	M	F	M
Senior Management Staff					78	172		5		2
Subject-matter Specialists					161	225	55	20	22	4
Field Level Extension Staff			430	800	1,620	940				
ICT Support Staff							5	5		
In-service Training Staff										
Total: 4,544			430	800	1,859	1,337	60	30	22	6

Source: Department of Agriculture MOAI 2011.

The extension coverage by various managers differs from locality to locality depending on several factors including communication facilities. On average, a village manager, who is supposed to maintain direct contacts with farmers, is required to cover a few village tracts or villages with 1,215 to 2,430 hectares of cropland. As many as ten village managers are supervised by each village tract manager. The village tract extension service is involved in promoting rural development.

3.2. Agricultural Extension Approaches, Methods, and Strategies

The traditional extension approach has been practiced in Myanmar since 1927. In this approach, village extension managers meet with farmers individually or in groups for discussions about technical problems and arrange field visits and field demonstrations.

In 1976, a World Bank project introduced the T&V approach in most of the rice growing areas in Myanmar. This approach succeeded by providing subject matter specialists: agronomists, entomologists, etc., and mobile facilities such as speedboats, small ships, and motorcycles. At the end of the project, however, this activity began to slow down because of

a reduction in the number of resource personnel and mobile facilities. In this system, an extension agent receives one day rotational training every fortnight from supervisors for some impact points (generally termed as lesson sheets) to be currently applied, and passes on the same messages to a few selected farmers called *contact farmers*.

The framework of the T&V approach consists of four components: farmer-groups, contact farmers, coverage of extension worker, and organizational structure. The T&V approach is basically a top-down approach, including the *transfer of technology* philosophy from research via extension to the farmer. Its contact farmer model (two- step flow of information) may also not be universally valid (report on the performance of extension activities, agricultural extension division, (MAS 1996).

In 1978, the Selective Concentrative Strategy approach was born in Myanmar for the whole township special high yielding paddy production program. The program was started during the 1979-80 fiscal year and extended to cover about 2.4 million hectares in 1981-82 and involved 78 townships. The paddy production has increased by a remarkable 65%, with a national yield raised from 1.65 tons per hectare in 1974 to almost 3 tons per hectare in 1982. The essence of the strategy is selective concentration. It consists of five components (Kyaw Zin 1986).

- 1) A correct and proven technology: a working group involving researchers and extension agents formulate technology packages in a simple fashion which will be put into practice after analyzing the research findings of a particular crop.
- 2) Selectivity and concentration: in view of the scarcity of the production inputs, such as seeds, fertilizers, and pesticides, selective concentrated townships are located in areas offering the most promising returns. Competent extension agents and subject matter specialists are selected so that they can concentrate their efforts on the program operation efficiently and effectively.
- 3) Governmental support and leadership: this plays a key role because the program to be implemented is a centralized diffusion system. For the program to run smoothly, the government at each level provides supportive measures as well as leadership.
- 4) Community organization and people involvement: the agricultural management committee formed at all levels (divisions, townships, village tracts, and villages). The members are responsible for both giving the advice and implementing the program. The people involvement activities are collective ploughing, collective harrowing, and collective transplanting.
- 5) Emulation and Competition: farmers are encouraged to emulate each other and to compete for high yield production. The government rewards the farmers who produce the highest paddy yield about 100 baskets/acre (12,000 kg/hectare). Likewise, the MAS rewards the staff members who make a significant contribution to the implementation of the program.

The Selective Concentrative Strategy approach is also utilized to improve the production of other crops. During 1980, the whole township high yielding varieties special programs were launched for maize, groundnut, sunflower, cotton, wheat, sorghum, jute, potato and pulses. These programs have already produced significant yield increases in cotton, maize, wheat, groundnut and sugarcane and the average yields were two to three times the national figures. The Selective Concentrative Strategy approach was put into effect for the program and was found to perform well under the Myanmar conditions.

The AED uses the following approaches and programs for updating agricultural techniques of farmers' communities:

- Large scale education camps;
- Farmers Field Schools;
- Ten-member farmers' groups (*Se-Le-Su*) for extension contacts;
- Training & Visit system;
- Special high-yielding programs;
- Special crop production zones;
- Block-wise crop production programs; and
- Farmers' participatory technology development approach.

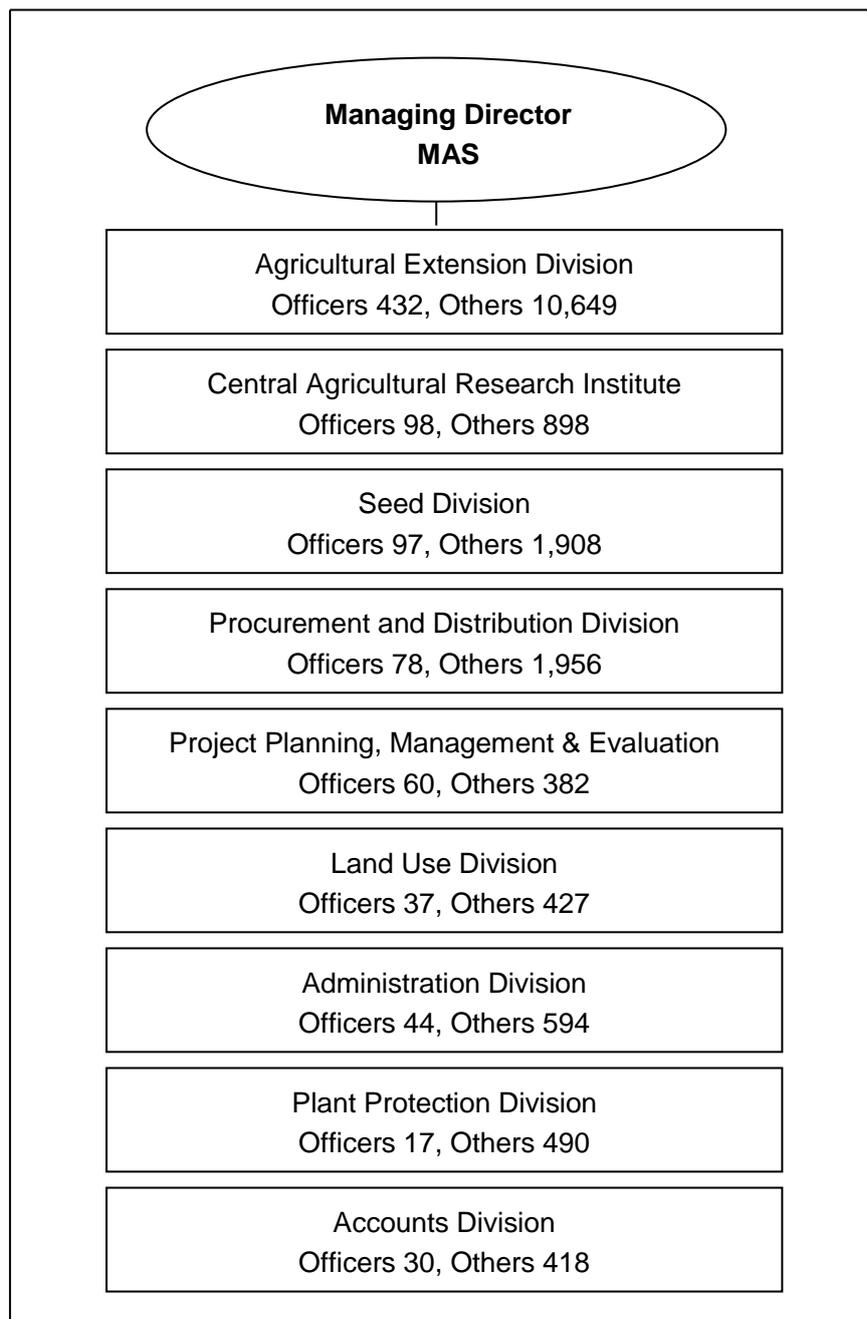
As of 2002, there were 35 seed farms, 17 research stations, 53 horticultural farms, 10 field crops farms, and 5 crop substituting farms in the opium cultivation areas—all under DOA. Among these, horticultural farms, field crops farms, and crop substituting farms are engaged in extension activities related to crop and horticultural production, crop protection, systematic fertilizer application and soil and water management. All these activities are undertaken under the supervision of the Agricultural Extension Division, which is also responsible for seed multiplication and distribution in coordination with the Department of Agricultural Research and the Seed Divisions for major crops, that is, rice, maize, pulses, oilseed, vegetables, and fruits.

3.3. Agricultural Extension of Myanmar Agriculture Service under the State Peace and Development Council Government

The Myanmar Agriculture Service, under MOAI, was composed of 9 divisions. The general managers from each of the nine divisions assisted the managing director of MAS (Figure 5.).

Figure 5 on the following page shows that out of a total 18,615 staff of MAS, 893 are officers (gazetted officers and above) and the rest 17,722 is made up of junior scientists and clerical staff. The AED occupies the largest portion of the total staff of MAS, having 11,081 personnel. AED has two main functions: a) transferring the appropriate and adaptable agricultural technologies to farmers, and b) collecting the information on field problems encountered by farmers. The MAS follows the national administration format, therefore the agricultural extension division plans the extension programs from divisional to township and township to village levels (Cho 2003).

Figure 5. Organizational Structure of Myanmar Agriculture Service



Source: Cho 2003.

Table 9. Yearly Budget Allocation to MAS and Agricultural Extension Service Kyats Million

Particular	1987-88	2000-01	2001-02	2002-03	2004-05	2005-06	2006-07
MAS total Budget	1,392.17	31,289	25,434	26,435	10,039	10,912	11,848
Extension Budget	275.56	1,038	1,444	1,623	1,992	1,608	3,491
Percentage	19.8	4.2	5.7	6.1	19.8	14.7	29.5

Source: FAO 1988; MAS 2001-02 to 2006-2007.

The State Peace and Development Council government allocated budget in varying amount from 1989 to 2003 but the allocation as of total MAS budget to extension increased steadily by 2005-06 (Table 9.). Considering the relatively large size of the extension division in MAS, the budget share should be increased more than the stated extent.

When the Department of Irrigation received the lion's share being about one third of the total Ministry budget, and Water Resource Utilization Department followed closely with 24 – 31% share, the allotment for MAS was not more than 3% of total capital expenditures. It appeared that limited capital budget could not support well for the strengthening the laboratories for technological development or vehicles and motorcycles needed for mobility of the extension workers. The information for budget allotment was however, limited to the first decade of the military government and no data ministry-wise was available since then.

The annual report of MAS Extension Division in 2009-2010 revealed the budget expenditure as of 2009-2010 (Table 10). It showed that no more budget expenditure was allowed under Seeds/implements Budget Heading. It was thought that the staff had improperly used the allotment of this budget. Overall, field works of extension education spent nearly 6,000 million kyats while management support used about 1,350 million kyats.

On the ground, the regular budget for carrying out the compulsory extension activities was allotted to each township amounting to three lakh (300,000 Ks.) per year. This is the set amount for establishing the model farm sown with pure seeds. The township manager is expected to use this fund about half for assisting the farmers in establishing model farm and the remaining amount to help the extension field staffs reaching out to the contact farmers and model farms. The model farm was in fact managed by farmers themselves from preparing the land to harvesting. However, for some improved practices or recommended methods to be adopted, extension field staffs are required to support the farmers with some incentive.

Table 10. Budget Allocation and Expenditure at MAS, as of 2009-2010 Budget Year, Kyats Million

Budget Head	Sanctioned	Actual Expenses
Seeds/implements	100.000	
Extension education (field works)	5,954.988	5,563.512
Extension education (management support)	1,351.134	1,321.319

Source: MAS 2010.

Moreover, field staffs themselves need travelling allowances and expenses for meals during their field trip. The daily travelling allowance sanctioned by the government is only 25 kyats per day which is unrealistically very low. The township extension officer does not set this amount but instead, the manager negotiates with the township authority accountant requesting him to pay three times the actual expenses of travelling to his field staffs during their trips. If he could seek sufficient budget from other budget sources to cover the field trip expenses of his staffs, he may manage to pay Ks. 5,000 per month to a village extension field staff, Ks. 7,500 to an assistant supervisor field staff, and Ks. 9,000-10,000 to deputy supervisor monthly. If the budget he sought is insufficient, the rate of informal payment is reduced to Ks. 3,000 to village field staff, Ks. 5,000 to an assistant supervisor and Ks. 7,000 to deputy supervisor per month. These payments do not come from the regular budget allotment to the model farm but only to make partial support to that budget.

If the township extension manager prefers to undertake other demonstration trials in his area, he needs to seek a sanctioned budget from the head office, in addition to the budget for model farm (Ks. 300,000). The pure seeds based- model farm is the compulsory extension task that must be undertaken in every township. That budget has already been allocated and put into all townships' funds. But for optional extension activities, an individual township manager has to approach the head office for what he needs. The budget sanction or availability of funds is not dependent upon the type of extension program being implemented. However, in actual practice, it depends upon his ability to communicate with and negotiate deals to get access to the head office authorities and contact with the clerical staff. In addition to his budget request, he may need to submit his plan or program but that may not be necessary to have access to funds. He also understands that half of the requested amount may be left at the head office and the remaining amount used for his extension program, if he cares to do so. Most extension managers have given up this process as the majority are keeping away from such groups and remain doing nothing in his area. An ambitious manager will secure the necessary funds and carry out the actual demonstration trials as long as he gets support to do it. This type is an exceptional case.

Since the time of the planned economy system of the socialist era, the primary task of the extension education division of the Department of Agriculture had changed from focusing on technology adaptation – dissemination process for farmers to responding to the driving forces of the government in its attempt to fulfill the national target of the agricultural sector. In response to such forces, the concerned agricultural agencies made all-out efforts in terms of budget, time, and manpower for gathering, compiling, summarizing, and reporting data of planned and actual cropping areas and the changing status of cultivation and production from the individual farm parcel through village, village tracts, townships, and divisions to the national level from day to day, or week to week. In an attempt to attain the targeted figure which in reality is a huge job, there were often tendencies of staffs at various levels to report on-paper progress with overestimation, manipulation, and falsification of the data which finally became almost a normal practice of the department. During this time, authorities would like to be impressed with the increase in GDP at either the state, divisional or national level. It almost always happened that the yearly national planned figures were formulated based upon the availability of the land stock, without considering the market or mobilization of the other resources, inputs, and manpower in terms of capacity, efficiencies, and motivation. The mentality (mindset) of most of the staffs was to have a tendency of reporting the figure close enough to the planned figure for all the cases which could not be checked easily. If they report figures well below the level corresponding to a presumed GDP rate, they have to put forward several explanations to the authorities and officials higher up. The weapon of the weakness became the practice of reporting the inflated or plainly speaking,

agreeable or pleasing figures. This mindset from the extension fields infested the field staffs working for technological verification, adaptation, and dissemination process.

With MAS engaging in such data-reporting processes, they are sacrificing manpower and time which otherwise could be devoted to the technology delivery process. Pulling out of this drudgery, MAS, in 2005 with mandate from the Minister of the Ministry of Agriculture and Irrigation switched the focus from the data-reporting tasks, to technology delivery process to farmers. But unfortunately, MAS extension forces were downsized in the same year due to the perception of the government that MAS no more requires large force of manpower since it has no obligation for data-reporting job. Before 2005, each village extension field staff could sustain the function of extension in not more than three to five villages but now his scope of responsibilities increased to more than several dozen villages. In some townships, a MAS office holds only three staff members; among them are the township manager himself, his deputy staff (either a village tract manager or deputy township manager), and finally an office clerk or office bookkeeper. This severe shortage of manpower reduces the capacity of the department to meet its expectation. A ray of hope is emerging in recent days as MAS is allowed to recruit 500 fresh agricultural graduates to fulfill the vacant posts.

Convincing the authorities requires patience and time for a divisional manager of the extension division of MAS. He is usually working under two command channels: first MOAI, his mother organization and second, a regional army commander. The latter channel is more important for him, thus, it is important to get along with the commander, because he is subjected to the commander's area administration and the commander exercises his control over the divisional Agricultural Management and Supervision Committee (AMSC) which consists of divisional agriculturally related officers from MAS, the Irrigation Department, the Agricultural Mechanization Department, etc. That committee has to follow the commander's trip around ten times a month and the chairman of the District General Administration Department frequently draws up the schedules of the commander's trip in consultation with the members of AMSC. The members in turn make an appropriate arrangement for displaying the showpieces or demonstration programs to the commander and party. The AMSC members attempt to convince the commander that what they have done for adoption of the technology impacts aspects of crop production. In his early tenure, the commander perceives that the scope of functions of the extension manager must be wide enough to encompass all aspects of the agricultural development program starting from reporting of data, covering planned and actual condition through several activities, to the ultimate problems occurring during export of crop commodities. He does not care to understand the actual terms and conditions of the MAS officers. The divisional manager of MAS has to be careful enough to reassure the commander by accompanying him on all the trips. Finally, the commander begins to understand the real situations, but by that time, he has to exit the command area to be replaced with a new incoming commander. The divisional manager then has to once again start the participatory learning process with the new authority.

3.4. Agricultural Knowledge, Information, and Technology

Agricultural research, education (training), and extension programs in Myanmar are covered through obtaining and utilizing agricultural knowledge, information, and technology (AKIT). Specific activities include research, collection of existing AKIT from other countries, training of research scientists and extension workers, provision for extension advice to farmers, and enabling farmers and community-based organizations to participate in the activities of farmer developed community or agricultural cooperatives. The training and extension programs are

organized with two objectives: first, to ensure that officials, farmers, and others interested in agri-business have access to and are well equipped to benefit from the best available AKIT related agriculture, agri-business, and farm management programs; second, to enable the rural community to take common action in matters of agriculture, agri-business, and farm management. Education of farmers is done through mass media (newspapers, radio, television, and journals), distribution of pamphlets, and training and visits by the extension agents to individuals or groups of farmers.

Agricultural extension services in Myanmar are traditional. Several factors pose as constraints in the meaningful development of its farmers. For example, extension program planning remains the prerogative of the government with little involvement of men and women farmers. In other words, farmers' extension needs are not taken into consideration. There are no well-established farmers' associations to constitute a strong lobby. All along, the emphasis has been on improved technology to enhance agricultural production while the importance of developing skills, knowledge, and proper attitudes of the farmers has not received much attention. Rural infrastructure, and farm infrastructure in particular, is underdeveloped and the electrification is scant. Low salaries and benefits, lack of mobility, and inadequate operational budgets lower the morale of the otherwise sufficient number of extension staff.

There is only one agricultural university whose role in supporting extension has not yet been defined. In addition, its agricultural extension curriculum is outdated. While it is good to see coordination among the Agricultural Extension Division, Seed Division, and the Department of Agricultural Research in several important activities, there is no evidence of the Agricultural Extension Division promoting cooperation among public and non-public institutions. In fact, contacting common farmers for imparting technical extension advice on food crops is not a high priority for the private sector. Due to government rules, NGOs also face a number of hurdles in carrying out human development work, especially in rural areas. Another factor that lengthens red tape in extension matters is too many layers of bureaucracy in the public extension service.

3.5. Training Options for Extension Professionals

An important factor relating to technology transfer is the human resource development. The MOAI therefore has been undertaking educational activities, such as pre-service training, in-service training, workshops, seminars, quarterly regular meeting, and an annual conference for its staff. In addition to the high education offerings, further training for agricultural extension agents to improve their knowledge and skills is being carried out at the Central Agricultural Research and Training Centre (CARTC), sometimes at the Central Agricultural Research Institute, and Myanmar Academy of Agriculture, Forestry, Livestock, and Fishery Sciences. The irrigation and agricultural mechanization departments also offer regular training for their own staff in related subject matters. The level of technical know-how of each area is also being upgraded through overseas training. The extension workers who received such training are doing their utmost to diffuse the technologies among farmers by means of demonstrations, field days, and field visits. The CARTC also provides pre-service training for graduates from Yezin Agricultural University and State Agricultural Institutes. Many of graduates from YAU and SAI are employed by the Extension Department. The graduates from YAU are appointed as village tract extension managers.

However, the graduates from SAI are appointed as village extension managers and they need at least four years of work experience to be promoted to village tract extension managers positions (Cho 2003).

3.5.1. Central Agricultural Research and Training Centre

The Central Agricultural Research and Training Centre was established with the financial assistance of JICA in 1984. The main objective of CARTC is to upgrade the technical knowledge and the efficiency of the extension agents through local training on modern agriculture technologies. In addition, CARTC organizes workshops and seminars to exchange the knowledge and experiences of the extension agents from respective regions throughout the country. CARTC has a training section responsible for carrying out of training and improvement of teaching materials, a field section for control and operation of the demonstration farm, a publication section for the compilation and printing of training materials and an audio-visual section for the operation and maintenance of training aids. CARTC provides pre-service training, in-service training, on-the-Job training and various kinds of technical training for the staff of the MOAI (Cho 2003).

Pre-service Training: This training is provided for new graduates from the Agricultural University and Agricultural Institutes for a period of one month. The duties and responsibilities of the extension agent and the ideology of agricultural extension activities are introduced. The curriculum is based mainly upon the theoretical education. Pre-service training consists of three sessions, namely practical, research and lecture as follows:

- Practical: cultivation of field crops and horticultural crops and utilization of farm machinery are being practised.
- Research: the main research activities are conducting the yield trials, plant breeding, drawing the experimental design, data analysis and interpretation, pure seed production, testing the herbicides and pesticides, analysis of the crop yield from the sample plots, and the crop production cost per hectare.
- Lecture: the main topics are objectives, policies, and measures of the Ministry of Agriculture and Irrigation, duties and responsibilities of extension staff, agricultural extension methods, and basic agricultural research activities. In addition, crop production technology, cropping system, soil fertility management, plant physiology, plant protection technology, systematic water utilization, crop yield estimation methods, pure seed production, agricultural mechanization, and agricultural meteorology are also emphasized.

In-service Training: This training program consists of four courses for extension staff and specialists in every field, such as subject matter specialists course, specialist comprehensive course, general agriculture and extension course (administrative training) and planning analysis course (advanced administrative training). The training period is one to two months. In-service training consists of three main sessions like pre-service training but this is more concentrated in practical rather than lecture. The research activities are the same as in pre-service training (Cho 2003).

For the practical session, the following activities are being practised: program planning, management of daily costs, drawing up a budget, harvesting the sample plot and estimation of the crop yield, variety selection and pure seed production, high technological modern

farming, irrigation methods, soil analysis for different crop cultivation, application of pesticides and insecticides, and utilization of farm machinery. The main topics emphasized in lecture session are agricultural development policies, seed technology, different cultivation methods, systematic utilization of chemical fertilizer for crop production, plant protection, weed control and management, post harvest technology, administration, budget, and statistics.

On-the-job Training/ Training Workshop: This training serves to improve the technical skill of extension staff from state/ division, district, township, village tract, and village levels. The training period covers one to two weeks. The curriculum applies to all levels of trainees and provides various kinds of technical training and laboratory exercise training (Cho 2003).

3.5.2. Central Agricultural Research Institute (Now DAR)

The Central Agricultural Research Institute (now Department of Agricultural Research-DAR) organizes some training for the extension agents in major crop production technology (rice, pulses, sesame, groundnut, sunflower), plant protection technology, soil and water management, and small farm machinery. The Irrigation Department and the Agricultural Mechanization Department offer regular training in related subject matters for their own staff. In addition, the Vegetables and Fruits Research and Development Centre, the Plant Protection Department, the state and divisional research stations and seed divisions also offer related training for extension agents and other MOAI staff.

3.5.3. Myanmar Academy of Agriculture, Forestry, Livestock, and Fishery Sciences

Myanmar Academy of Agricultural, Forestry, Livestock, and Fishery Sciences was established by the government in 1999. The main objective of the academy is to promote the science and technology for the development of national economy, and collaborate with international scientific institutions. The mandate of the academy is to assist in the implementation of human resource development programs through various types of training for the existing staff. Another approach is to organize the young scientists from different fields to conduct research and to write papers on new findings, which could be published later.

Although the Ministry of Agriculture offered different areas of training, specialized training programs based on farmers' needs and constraints, agro-ecological and socio-economic conditions, and realities of research and extension organizations are virtually non-existent. In Myanmar, extension officials and extension agents lack the needed knowledge about market-driven and pluralistic agricultural extension and advisory systems.

Papers by Cho and Boland (2004a and b), based on a research study conducted in Myanmar in April 2001, shows the in-country and overseas training received by extension agents from seven different regions of Myanmar (Tables 11 and 12 that follow).

Table 11. Extent of Training in Technical Disciplines Received by Extension Agents in Myanmar during the Period 1995-2000

Technical discipline in which training was provided	Percentage of content received through training
Crop production	33%
Advanced administration	31%
Soil and water management	14%
Plant protection	7%
Agricultural extension	5%
Other subjects	4%
Agricultural economics	3%
Seed technology	3%

Source: Cho and Boland 2004a and b.

Table 12. Overseas Training Received by Extension Agents of Myanmar during the Period 1995-2000

Countries in Which Training Received	Duration of Training (days)	Number of Trainees	Areas of Training
Mexico	120	1	Wheat production technology
Thailand	20	1	Sustainable agriculture and rural development
Thailand	40	1	Rice production technology
Korea	40	1	Rice production technology
Japan	40	1	Flower wheat cultivation and processing
Nepal	5	1	Agriculture development in mountain regions
Thailand	35	1	Post-harvest technology
China	20	1	Hybrid rice production technology
Japan	40	1	Integrated agriculture and rural development through participation of local farmers

Source: Cho and Boland 2004a and b.

The study also revealed further specific training needs in ten technical subjects as expressed by the extension agents in the following order of priority:

1. Extension education;
2. Rice production technology;
3. Market information advice;
4. Pure seed production;
5. Post-harvest technology;
6. Pulses and oil seeds crop production technology;
7. Cropping system;
8. Industrial crop production;
9. Plant protection technology; and
10. Farm mechanization.

3.6. Information and Communication Technology for Agricultural Extension

Myanmar started installing ICT tools/applications more than ten years ago. Presently, there are over 250 ICT companies in the country. The ICT coverage for some of Myanmar's rural areas was initiated by the Post and Telecommunications Department, which is organizationally under the Myanmar Post and Communication. A multi-purpose community tele-center was set up at Phaunggyi village which is located about 48 miles from Yangon. The center is assisted by the Telecommunication Development Bureau (TDB), and its purpose is to improve living standard of people living in rural areas. The government plans to install about 6,000 small satellite terminals at remote areas within three years or so.

Myanmar's telephone system is the least developed in the ASEAN region and its electrical system ranks second to last, behind Cambodia. According to the World Bank, in 2010, the number of mobile cellular subscriptions in Myanmar was 1.23%. During the same year, the number of Internet users in the country was 0.22%. However, the number of mobile phone users dramatically changed in 2012, an increasing number of people now have mobile phones in urban areas. In rural areas, however, only about 4% of the population has access to a cell phone (Barca 2012 Table 90). Starting from November 2012 free Wi-Fi access is provided by some public and private organizations in the city of Yangon and many other towns across the country and increasing number of people have mobile phone with internet access. Efforts are underway to liberalize and accelerate penetration rates by liberalizing the telecommunication sector.

There has been talk of establishing an e-agriculture information center in Myanmar to efficiently publish and share essential information for agricultural business. The center will serve two ways of education: the main source of agricultural product distribution information; and answering calls from farmers re their field technical problems. Also, a website will be launched for information sharing.

According to the extension management, publications are available on-line, around 60 to 65 television programs are telecast per month, and about 16 radio programs are broadcast per month. In addition, a number of information bulletins and fact sheets are being distributed to some farmers, but we are uncertain about the number of farmers actually receiving these educational factsheets/information bulletins. Other than that, there is no evidence of any significant modern ICT application in support of extension programs being used.

Extension information and communication are essential components of the development process; yet these systems are rarely well integrated into development strategies and programs. For example, the rush to develop Internet access in developing countries needs to be adjusted to the context of already established and effective communication systems, and attention needs to be paid to bridging the rural digital divide between those who can afford access to the new technologies and those who cannot. A very important consideration is that information technology tools should facilitate the work of extension agents, not replace them.

Stakeholder participation in decision-making processes is crucial and requires multi-sectoral collaboration and partnerships. Partnership is another way of saying "coordination". There are numerous, and interrelated, actors involved in development. Recognizing this pluralistic environment means that extension must become more *extraverted* and cooperate with other agencies within the public sector and with various organizations in the private sector.

3.7. Institutional Linkages for Pluralistic Agricultural Extension System

A farmer-centered, service-oriented extension system provides the conduit through which common farmer problems get identified and flagged for the attention of researchers so they can help farmers to solve practical problems that limit farm productivity.

Linkages between extension professionals and researchers are generally very weak in Myanmar. Extension agents rarely come to the research stations and researchers do not routinely visit extension offices or demonstration sites. The link between farmers and extension agents are also limited. Farmers rarely see extension agents in the field. Farmers get some technical information from local agro-input dealers like fertilizer, insecticide, and pesticide distributors.

Not long ago, the government has created Myanmar Rice Industry Association (MRIA) to promote the export of rice. The MRIA has been created by merging three existing associations namely, the Myanmar Rice and Traders' Association, the Myanmar Millers' Association and the Myanmar Paddy Producers' Association. In September 2012, MRIA changed the name as Myanmar Rice Federation (MRF). Myanmar Agribusiness Public Corporation (MAPCO) is a wholly owned non-government public corporation, established in September 2012. MAPCO is formed to mobilize public savings and to foster broader investment in agriculture and agro-based industries of Myanmar.

In general, there has been little encouragement in Myanmar to form farmers' associations at village level and above. Apart from farmers' groups (Rice farmers' group and vegetable growers group) formed by the Department of Agriculture, no significant extension-related associations exist. The following two associations have been identified but they are commercial and export-oriented in character:

- Myanmar Fish Farmers Association (MFFA)
- Myanmar Rubber Planters and Producers' Association (MRPPA)

The main problems faced by the current agricultural extension service were required to determine before making suggestions on further development of extension services and formulating an efficient extension system for Myanmar. Table 13 on the following page shows the twelve main factors affecting the performance of extension activities identified by Khin Mar Cho in her research conducted in 2001.

In promoting development of participatory agricultural extension services in Myanmar the effective institutional linkages between governmental and non-governmental organizations will be required. In addition, farmers' organizations will play a vital role. With this in mind an institutional network that can serve as a linking system for the government organizations (extension, research, and training institutions), international NGOs, and the UNDP in Myanmar, as well as farmers' association was proposed by Khin Mar Cho in 2003 based on her research findings (Figure 6). She also recommended a networking organizational structure covering the responsibilities of these organizations for the participatory extension movement in Myanmar (Figure 7).

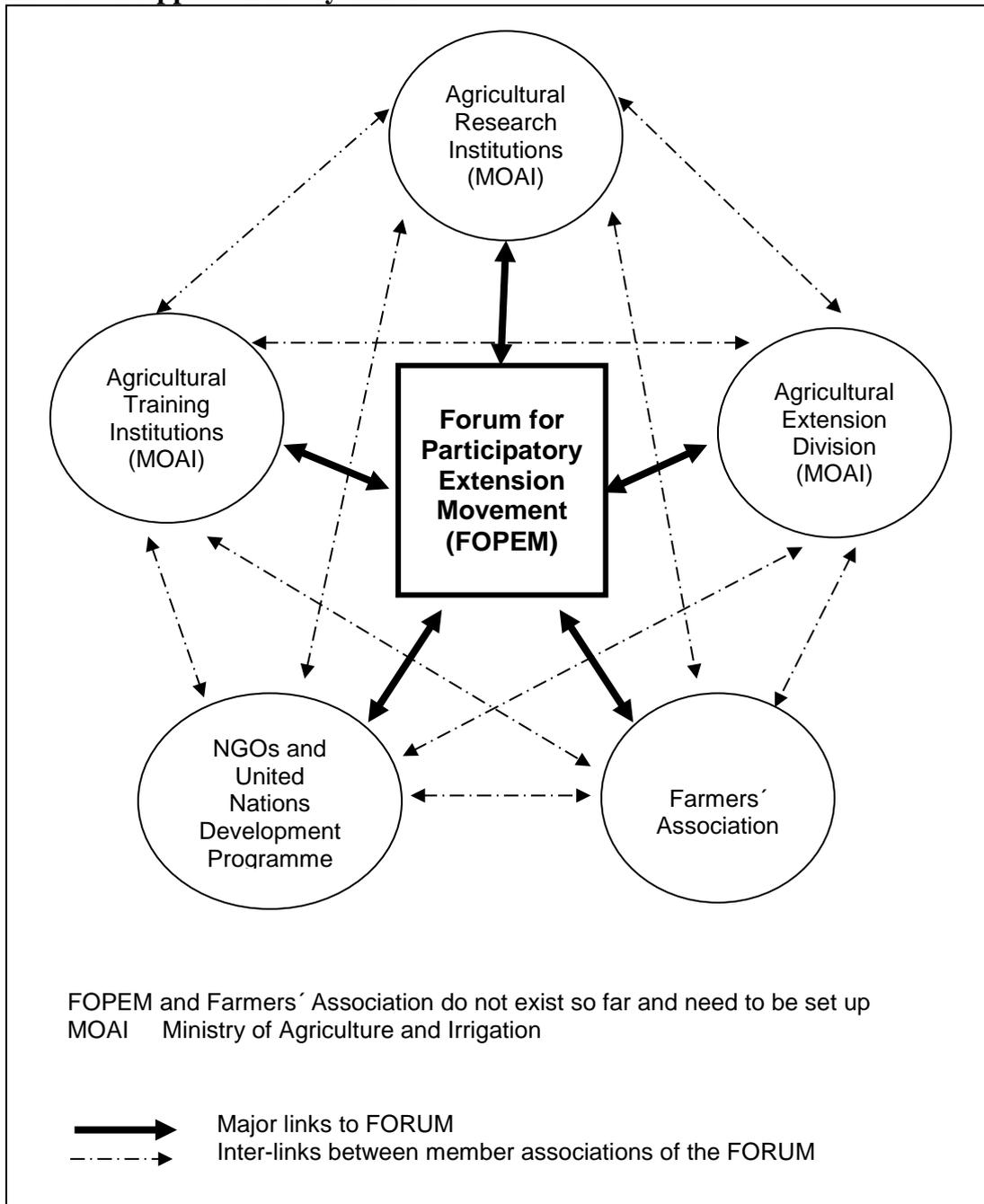
Table 13. Perceptions of Extension Agents on Factors Affecting the Performance of Extension Activities

Statements	Number of responses (N=130)				Mean values
	Degree of hindering				
	Strong (4)*	Moderate (3)	Less (2)	No (1)	
1. Farmers' inadequate technical knowledge in agriculture	101	29	0	0	3.78
2. Lack of proper extension programs for the needs of the local community	95	35	0	0	3.73
3. Poor transportation facilities	82	48	0	0	3.63
4. Lack of suitable market and price assurance for farm products	71	59	0	0	3.55
5. Lack of farmers' finance	69	61	0	0	3.53
6. Inadequate extension agent	60	70	0	0	3.46
7. Too many farmers to advise	59	71	0	0	3.45
8. No insurance for crop damage	49	81	0	0	3.38
9. Responsibility for research experiments	39	91	0	0	3.30
10. No cooperation of local people in program implementation	34	91	5	0	3.22
11. Illiteracy of farmers	29	97	4	0	3.19
12. Reluctance of farmers to accept new technology	23	101	6	0	3.13

Source: Cho 2003.

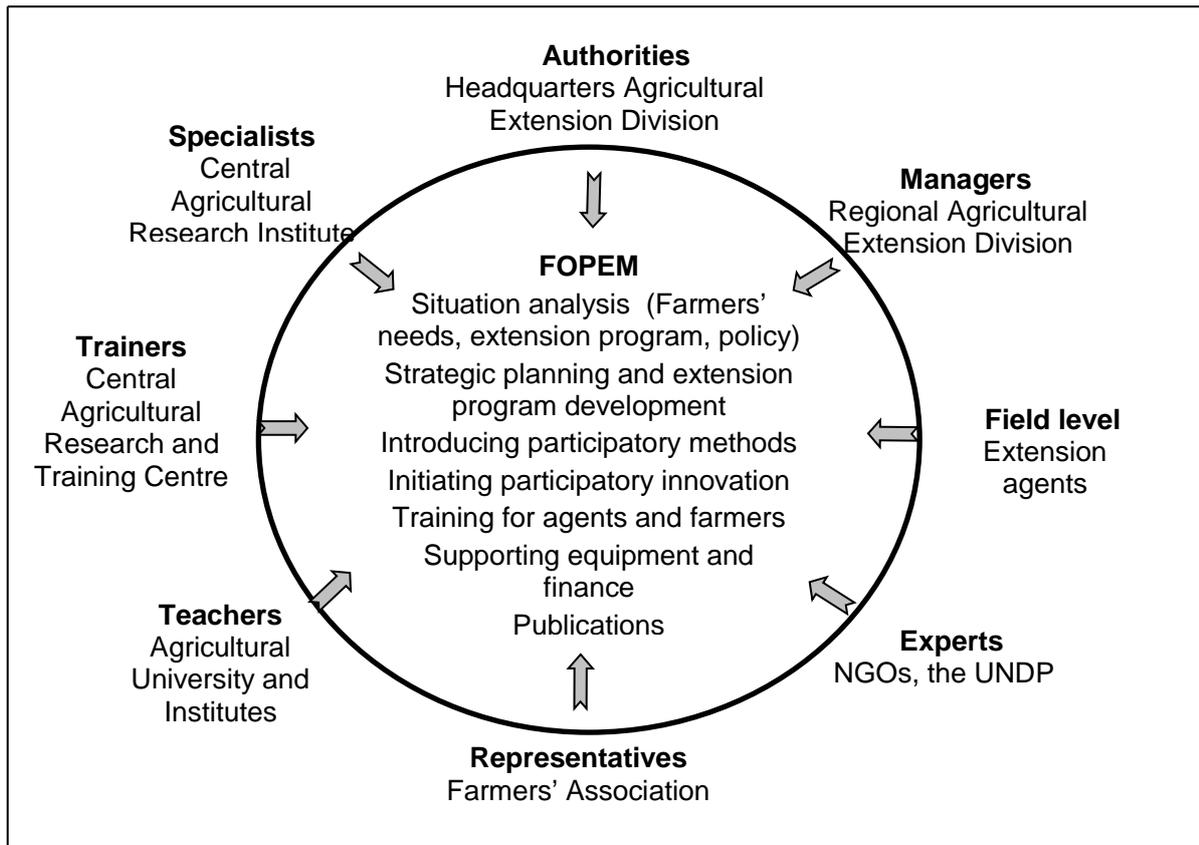
* Figures in brackets indicating assigned scores for the corresponding statements.

Figure 6. The Proposed Institutional Model for the Implementation of a Participatory Extension Approach in Myanmar



Source: Cho 2003.

Figure 7. Organizational Structure of the Proposed Forum for Participatory Extension Movement



Source: Cho 2003.

3.8. Process of Reform Extension Strategies

In Myanmar under the president U Thein Sein’s administration, political changes, reform agenda, and trade openness brought the agriculture sector in better position to transform into an agribusiness structure.

MOAI is now preparing regional integration and revising land and virgin land law. Foreign companies are now seeking opportunities in feasible areas of Myanmar Agri-business. Across the regional economic corridors, Myanmar is now in a turning point of its agricultural transformation.

It is expected to cover the supply of agri-inputs, production, and transformation of farm produces and distribution to final consumers. Their role will be increasingly important in strengthening linkages between agribusiness farms, farmers, retailers, and other throughout the supply chain.

The structure of Myanmar agriculture is predominantly composed of small farmers. About 56% of the total farm households in the whole country are working on farm holdings with smaller than five acres. Despite working hard in the fields, they do not often enjoy a fair profit share in the commodity supply chains. Some business entrepreneurs exploited farmers by adopting unfair contract farming. They lose bargaining power because after they had sold their farm products, the prices often went up. The government’s rural development programs in collaboration with the international communities have been directed to improve the rural

livelihood of the rural people. Reform strategy and development plan of the Agricultural Extension Division includes the following:

- Strengthening agricultural extension mechanism and information dissemination systems for rural development;
 - Mobile facilities for agricultural extension staff,
 - Conducting demonstration fields and experimental field,
 - Provision of mobile vehicles for quick information assessment for farmers,
 - Establishment of modern farms for rice, sunflower, groundnut, and other important crops, and
 - Establishment of updated extension camp in states and regions.
- Provision of intensive training to produce quality seeds and grains,
- Establishment of modern rice mill to get quality rice and paddy, and
- Strengthening agro-based industry for fruits and vegetables.

3.8.1. Reform Areas in Agriculture Sector Development (Policy Statement from the Ministry of Agriculture, Myanmar)

1. Reform for land management and administration (Precision of land, land map, and land record for effective land management);
2. Reform for advanced agricultural practices and seed industry (Dissemination of good agricultural practices (GAP) and seed production of high yielding crop varieties for increases production);
3. Reform for water resource management (Construction and effective operation of reservoir and dams, pumping, and flood protection for efficient use of water resource);
4. Reform for agricultural mechanization (Systematic cultivated land reform for switching to mechanized agriculture);
5. Reform for advanced agro-based industry (Development of agro-based industries including construction of chemical and fertilizer factories and modernized rice mills for value added agricultural products);
6. Reform for human resource development (Development of human resources in agricultural sector);
7. Reform for research and technology development (Development of agricultural research and technology);
8. Reform for Credit Services (Development of farm credit systems for supply chain); and
9. Reform for market information service (Information and data accumulation for development of agro-marketing system).

3.9. Extension for Food Security in Myanmar

3.9.1. The Role of Extension

Today, extension is more than it used to be. Its function and tasks are increasingly assumed by multiple public and private organizations. In developed countries, and in countries where extension reform has been pursued, pluralistic involvement of extension providers now exists- including non-profit non-governmental organizations, for-profit private companies,

rural producer organizations, commercial individual and associations of extension specialists, as well as national, state, and municipal extension services.

A new vision for extension is needed- one that views extension as a main pillar in serving the public good of food security, taking into account the immediate and potential impact of external forces, such as globalization and trade liberalization. Future economic and social development needs to be considered in the light of production, marketing, and micro-enterprise development of poor people in the rural sector.

Strategy for a new extension vision involves determining target areas and populations, calculating the potential and capacities of these targets, and developing appropriate programs- in cooperation with targeted populations- to promote the necessary capacities to meet the needs and demands of the target areas and populations selected. Once these basics are determined, complementary actions need to be undertaken, viz.:

- Design differentiated strategies to reduce poverty and food insecurity;
- Pursue approaches that recognize diverse livelihoods;
- Implement programs to strengthen producer capacity;
- Focus on development of human and social capital; and
- Establish social safety nets to enhance food security of the very poor.

3.9.2. *Points to Consider*

- Determine who should pay: A new consensus is needed on who should pay for extension, communication, and information services for poor rural communities;
- Ensure equitable access: New systems must deliver the right kind of information and extension advice in the right format for poor people, to ensure that existing inequities are not exacerbated;
- Promote local content: It may be more useful to promote information sharing between local institutions than bring in new information from outside;
- Strengthen existing policies and systems: Further work is needed to strengthen extension and communication policies, and new systems would seek to build on existing systems;
- Build capacity: Capacity building is needed at all levels, to equip people with the new skills necessary to develop and manage new systems;
- Use realistic technologies: The most effective systems use realistic technologies that enhance and add value to existing systems; and
- Build knowledge partnerships: New technologies provide enormous opportunities to build knowledge partnerships that cross national, ethnic and social boundaries.

3.9.3. *A Pluralistic Extension Network*

In principle, a pluralistic extension network aims to promote the advancement of *mixed economies* whereby public and private sectors cooperate more closely. A study on the rate of adoption indicates that high rates of adoption of improved agricultural technologies occur when government organizations, NGOs, and private organizations form partnerships in extending agricultural technologies to farmers. A pluralistic extension pattern demands that programs be jointly planned, implemented, and evaluated by all service providers, in active collaboration with farmers. The role of the government becomes crucial in a pluralistic

extension situation in terms of national policy direction, coordination, and quality control to safeguard the interests of farming communities.

3.9.4. Focus on Development of Human and Social Capital

Food security is a mammoth challenge. The public sector alone cannot finance, let alone deliver, extension services to meet all requirements. Also, as funding has generally been reduced for public sector extension services, field extension agents have been downsized and those who remain are less able to operate effectively at village level, especially in remote areas. A reassessment of how to ensure maximum impact from the use of public sector resources is needed. Following assessments and mapping of food insecure areas, a division of labor could be determined whereby different entities undertook distinct efforts either within an area or between areas.

Separated agencies, organizations, and projects working without coordination will not achieve the goals of the World Food Summit. If food insecurity is to be tackled full-scale, then a concerted integrated national approach is a major first step, one that involves farmers and community at the decision-making level. Demand-driven extension, i.e., extension programs based on the needs and demands of food-deficit producers and communities, needs to be strengthened through a wider variety of institutional interventions than just public sector extension. If the poor are to benefit from extension, extension reform is needed but importantly, reform that promotes local programs within the framework of a national integrated food security strategy that helps the poor enter society's mainstream.

3.10. To Re-Emphasize

3.10.1. Extension Alone Cannot Do It

Extension is a support and educational agency focusing on changing human behavior in positive sense, and as such is a very important actor in any national strategy of food security. However, no matter how efficient is an extension system, how qualified and competent its human resources, how generous financing it enjoys and how sound is its operational strategy, extension alone cannot guarantee sustained food security.

3.10.2. The Key Is an Integrated Approach

While extension is allowed to play its role within the context of new vision, the governments should:

- build platform to promote dialogue and cooperation among relevant institutions and programs in all sectors to develop a network for food security and income generation;
- create multi-disciplinary agricultural and rural development teams to respond to rural community-expressed needs;
- build technical and operational capacity of public and private service providers as well as recipients;
- establish and maintain links between policy-makers, support services, small farmers and markets;
- explore multiple programs methodologies; and
- create participatory mechanism to upscale proven best practices in food security.

REFERENCES

- Barca, Valentina and Nils Riemenschneider with the collaboration of Kyaw Shaw, Hnin Nu Hlaing, Ei Ei Htwe, Kyaw Linn Htet, Kyaw Min Htun. 2012. Delta 1 Evaluation Report. Yangon: Livelihoods and Food Security Trust Fund (LIFT).
- Cho, Khin Mar. 2003. Guidelines for the Implementation of a Participatory Extension Approach: An Empirical Study of the Training Needs of Agricultural Extension Agents in Myanmar. Weikersheim, Germany: Margraf Publishers.
- Cho, Khin Mar. 2007. Evaluating Agricultural Extension System in Myanmar: Present Situations and Future Prospects. In *Issues and Challenges in Rural Development, Volume II*, ed. Siegfried Bauer and Lila Karki. Weikersheim, Germany: Margraf Publishers.
- Cho, Khin Mar and Hermann Boland. 2003. Searching Institutional Linkages for the Implementation of a Participatory Extension Approach in Myanmar. Paper presented at the 19th Annual Conference of The Association for International Agricultural and Extension Education (AIAEE), 8-12 April. Raleigh, North Carolina, USA.
- Cho, Khin Mar and Hermann Boland. 2004a. Agricultural Training in Myanmar: Extension Agents' Perceptions of Training Needs. *Journal of International Agricultural and Extension Education (JIAEE)*. 11.1: 5-14.
- Cho, Khin Mar and Hermann Boland. 2004b. Education and Extension for Multi-functional Agriculture: Extension Concepts for Sustainable Agricultural Development in Myanmar. Paper presented at the 20th Annual Conference of the Association for International Agricultural Extension and Education, 23-29 May. Dublin, Ireland.
- Department of Agriculture Research (DAR). 2012. PPT slides and DAR Information Booklet. Yangon: Myanmar Department of Agriculture Research.
- Food and Agricultural Organization of the United Nations (FAO). 1988.
- Food and Agricultural Organization of the United Nations (FAO). 2010. Investment Assessment Project Survey 2009. Rome: FAO.
- Kyaw Zin. 1986. *Burma and the CGIAR Centres: A Study for their Collaboration in Agricultural Research*. Consultative Group on International Agricultural Research (CGIAR) Study Paper No. 19. Washington, D.C.: The World Bank.
- Ministry of Agriculture and Irrigation. 2011. Talking Figures: Some Statistics in Agriculture of Myanmar and Asia-Pacific Region. Yangon, Myanmar: MOAI.
- Ministry of Agriculture and Irrigation. 2012. Myanmar Agriculture in Brief 2012. Yangon, Myanmar: MOAI.
- Myanmar Agriculture Service (MAS). 2001-02 to 2006-2007. Yangon, Myanmar: MAS.
- Myanmar Agriculture Service (MAS). 2010. Agricultural Extension Division (AED) Annual Report 2009-2010. Yangon, Myanmar: MAS.

MAS. 1996. Report on the Performance of Extension Activities, Agricultural Extension Division. Yangon, Myanmar: Myanmar Agriculture Service.

Stads, Gert-Jan and Pau Sian Kam. 2007. *Myanmar. Agricultural Science and Technology Indicators (ASTI)* IFPRI Country Brief No.38. Washington, D.C.: International Food Policy Research Institute.

The Yezin Agricultural University (YAU). 2012. PPT presentation slides and University Information booklet. Yezin, Myanmar: Yezin Agricultural University.