

intensively raised poultry in commercial production systems, but it is obtained with minimum inputs in terms of housing, disease control, management and supplementary feeding. Village poultry have many advantages in mixed farming systems as they are small, reproduce easily, do not need large investments and can scavenge for food. Chickens are the most common species, but mixed flocks including species such as ducks, geese, turkeys or guinea fowls also often exist. Livestock, dairy, sheep/goat and pig products provide an example of high-value agricultural produce, with roughly three out of four agricultural households already keeping livestock, and therefore represent an important means for poverty reduction.

Livestock have a variety of characteristics that make them important contributors to sustainable rural development. They provide marketable products that can be produced by small-scale, household production systems, and are generally of higher value and less vulnerable to critical harvest timing than many crops. As an agricultural product with relatively high income elasticity, livestock are particularly attractive as a means for rural households to participate in urban-based economic growth. Livestock are also productive assets, which contribute directly to farm output through animal traction and indirectly as a store of wealth for future investment. Finally, they can contribute to soil fertility and recycling of agricultural waste.

Table 11: Estimate cost and return in 3 variety crops based on 1 hectare cultivated land

No.	Description	1 st crop (paddy)	2 nd crop (groundnut)	3 rd crop (paddy)	Total
(1)	(2)	(3)	(4)	(5)	(6)
1.	Production cost	538,060 ks	658,522 ks	538,060 ks	1,734,642 ks
2.	Yield	5,156 kg/ha	1,401 kg/ha	5,156 kg/ha	
3.	Income	882,035 ks	1,094,400 ks	882,035 ks	2,858,470 ks

Source: Ministry of Agriculture and Irrigation, Department of Agriculture

Table 12: Estimate cost and return in 2000 broiler production based on 1 hectare cultivated land

No.	Description	Total
(1)	(2)	(3)
1	Cost	7,500,000 ks
2	Income	7,830,000 ks
3	Net income for 1 cycle	330,000 ks
4	Net income for 6 cycle	1,980,000 ks

4. The advantages of an integrated crop-livestock farming system

An integrated farming system consists of a range of resource-saving practices that aim to achieve acceptable profits and high and sustained production levels, while minimizing the negative effects of intensive farming and preserving the environment. Based on the principle of enhancing natural biological processes above and below the ground, the integrated system represents a winning combination that: (a) reduces erosion; (b) increases crop yields, soil biological activity and nutrient recycling; (c) intensifies land use, improving profits; and (d) helps reduce poverty and malnutrition and strengthen environmental sustainability.

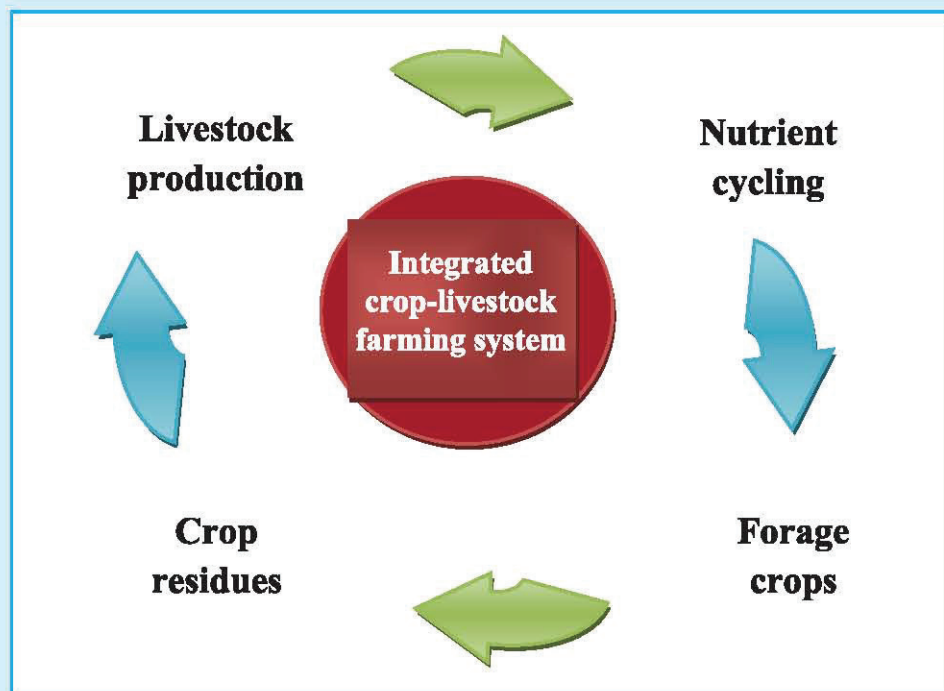


Figure 13. Integrated crop-livestock farming system

In an integrated system, livestock and crops are produced within a coordinated framework. The waste products of one component serve as a resource for the other. For example, manure is used to enhance crop production; crop residues and byproducts feed the animals, supplementing often inadequate feed supplies, thus contributing to improved animal nutrition and productivity.

Cattle breeding and cropping model

If two local cows are kept in the paddy field:

Available feed for cows

1. Agro byproducts for cattle feed
2. Grazing post-harvest
3. Cut and feeding in rainy season
4. Alternate grazing by tethering
5. Feeding rice straw, grain husk, rice bran, broken rice, cakes.

Available benefits for crops and humans

1. Manure is used as fertilizer for crops
2. Produce calves for draught power for agriculture purposes
3. Produce draught power in thrashing paddy stalk in threshing ground
4. Sometimes used in rural transportation
5. Produce milk for family consumption.

Table 13 shows the cost and return for small-scale livestock farming, dairy cattle, pig and chicken that are kept in the homelot.

Table 13: Estimate cost and return of small scale livestock economy

No.	Description	2 Dairy cow (within 3 years)	11 Native chicken (within 1 year)	2 Sow (within 3 years)
(1)	(2)	(3)	(4)	(5)
1	Primary investment	1,050,000 ks	32,000 ks	240,000 ks
	Cost			
2	Feed cost	1,752,000 ks	33,000 ks	975,500 ks
3	Other cost	150,000 ks	5,000 ks	30,000 ks
	Total cost	2,952,000 ks	70,000 ks	1,255,500 ks
	Income			
4	Animal & animal product sale	3,555,000 ks	178,700 ks	2,880,000 ks
5	Animal closing stock value	1,200,000 ks	-	360,000 ks
	Total income	4,755,000 ks	178,700 ks	3,240,000 ks

5. Conclusions

The results of the MCA 2010 revealed that over 4.3 million household holdings were engaged in livestock raising and most holders of those livestock holdings were males comprising 90.6 percent of the total whereas female holders comprised 9.4 percent only. Among livestock holdings, 15,755 holdings were reported to be growing crops around their holdings. About 4,079 holdings were reported that they planted annual crops and 11,676 holdings reported that they grew permanent crops within and around the holdings. Small farm systems constitute an integral part of agriculture. These systems, which are labour intensive and combine animals with mixed cropping, comprise a preponderance of small farms and a complex production system that is unique to the country.

A total of 12,658,000 large livestock were raised and more than three-fourths (77.85 percent) were over three years of age and only 6.24 percent were under one year. The systems utilize draught power from animals, produce crops for home use, allow the sale of animal feed and animal products for domestic consumption and commercial sale. Crops and animals thus play an important complementary role in the use of available natural resources and the achievement of sufficiency with respect to feed, fertilizer and requirements for human food.

Agriculture and livestock remain important components of the economy and society of Myanmar and the growth of the livestock sector has outpaced growth in crop production. In rural areas especially, the large majority of the people tend to be involved in livestock production in one way or another. Livestock production is still largely in the hands of small holders and characterized by low input and output and hence, low levels of production per animal.

In conclusion, it is suggested strongly that livestock production combined with crop cultivation represents a key solution for enhancing livestock production and safeguarding the environment through prudent and efficient resource use.

6. Recommendations

Mixed systems should be adopted as a cost and labour saving approach for small holder farmers, especially for the farmers' households without sufficient labour. These integrated systems reduce the drudgery and work load in the field, thus saving time which could be dedicated to do other things, such as income diversification, off-farm employment,

attending learning events or taking care of household chores and spending more time with family and children.

Integrated crop-livestock systems present an opportunity to collaborate with the private sector, especially with livestock-related business activities. This could be done for instance through production input supply and training, as well as for facilitating access to finance, equipment and machinery.

According to the result of the MCA 2010, most livestock holdings kept livestock animals in their homelots and backyards. Capacity building of local producers should be arranged with respect to integrated livestock and crop farming systems.

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**The Republic of the Union of Myanmar
Ministry of Livestock and Fisheries
Department of Fisheries**

**Aquaculture: A Potential Major Economic
Activity in Myanmar**

Dr. Aung Naing Oo

Abstract

A total of 12,512 household holdings practiced aquaculture in Rakhine state, and in the Ayeyarwady and Yangon regions of Myanmar. Pond culture was the main means of production, followed by rice-cum-fish culture. The majority of ponds used for culture were between one acre and under three acres but the largest ponds were 50 acres and over. Myanmar's aquaculture production was mainly conducted in freshwater areas. Ponds were the major production facility in freshwater (79.99 percent) and in brackish water (75.52 percent). The top five cultured species were shrimp/prawn (43.53 percent), rohu (*nga myit chin*) (25.60 percent), Chinese carps (11.65 percent), tilapia (7.5 percent) and common carp (5.0 percent). Most of the households' aquafarmers in Rakhine and Shan East states and Ayeyarwady, Yangon and Sagaing regions consumed or sold their products. Fry were produced by 203 hatcheries/nurseries and 597 ponds whereas 2,575 aquafarms produced fingerlings. Most of the fish and shrimp/prawn fry and fingerlings were produced in the regions/states of Rakhine, Yangon, Ayeyarwady, Mandalay, Shan East, Bago (East and West), and Sagaing. Water pumps were the most common item of machinery/equipment used by the household aquafarmers. Storage buildings and fish processing facilities were commonly used in most of the household aquaculture holdings. Male household members aged 40 to 49 years old operated most of the household aquaculture holdings. Crops were planted beside or in the vicinity of the aquafarm in 3,593 household aquaculture holdings.

Key words: Aquaculture, fish, production facilities, Myanmar

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Aquaculture: a potential major economic activity in Myanmar¹

Dr. Aung Naing Oo²

1. Introduction

Myanmar is endowed with freshwater, brackish water and marine fishery resources. Such invaluable fishery resources need to be exploited effectively if the production capacity of the aquaculture sector is to be raised. Myanmar's aquaculture production sector is dominated by the private sector through the rearing of fish using a pond-based culture system. The Department of Fisheries (DoF) of the Ministry of Livestock and Fisheries (MoLF) is mainly responsible for the following: (a) providing the technical know-how of fish culture and supplying good quality of fish seed for fish farmers; (b) ensuring replacement of fish and prawn seeds into the natural water bodies; (c) conducting research on marine and freshwater aquaculture; (d) educating and disseminating advanced aquaculture technologies to fish farmers; and (e) implementing good aquaculture practices (GAP) through conducting environment-friendly aquaculture methods for sustainable aquaculture development. Freshwater fish culture is more developed than the culture of marine shrimp and other aquatic animals in Myanmar.

Aquaculture areas have increased steadily from year to year since 1990/1991 and this continues until now. The total area increased from 12,255 ha (1990/1991) to 64,438.8 ha (2000/2001) and then to 179,633.6 ha (2010/2011) and 182,299.75 ha (2012). The annual aquaculture production also increased steadily from 6,397 MT in 1990/1991 to 128,225 MT (2000/2001) and 316,825 MT (2010/2011). In 2011/2012, aquaculture production for food increased to 880,833.6 MT, which was an increase of 7.84 percent compared to 816,820 MT in 2010/2011. The value of aquaculture production also increased from US\$ 377.56 million in 2010/2011 to US\$ 411.62 million in 2011/2012. Freshwater fish culture dominated this subsector, contributing 93.66 percent or 824,987.2 MT whereas mariculture (marine culture), contributed 6.34 percent or 55,846.4 MT. In 2011/2012, 880,833.6 MT of fish/shrimp valued at US\$ 411.62 million were produced from 182,299.75 ha of aquaculture areas, which included 89,138.178 ha of fish ponds, 92,428.307 ha of shrimp ponds and 733.271 ha of soft-shelled mud crab culture ponds.

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2. Freshwater aquaculture development in Myanmar

Myanmar initiated the fish culture of rearing *Tilapia mossambicus*, gouramy and common carp in 1954. At first, there was little interest among the people of Myanmar since the country was endowed with ample fishery resources and it was easier to harvest from the wild rather than farm. After the success of fish seed production through induced breeding techniques in early 1960, freshwater fish farming began to spread throughout the country. The number of fish farmers increased from about 40 people (during 1961/62) to 60 (during 1962/63) and the fish culture areas were enlarged from 200 acres to 600 acres. In 1964/65, the People's Pearl and Fisheries Cooperation established a 500 acres fish farm at Tuntay, which was the biggest fish farm in the Southeast Asia region at that time. At the same time, the DoF established Hlawghar Fisheries Station with 37 acres of grow-out ponds. There were only 6,300 acres of lands provided for fish ponds for the whole country in 1988 because land utilization was one of the major constraints. The aquaculture law was promulgated in 1990 and land utilization was becoming more flexible. The fish pond culture areas increased to 49,047 acres in 1998 because of the development of the aquaculture law in 1989, which meant that fish farmers had good opportunities for their investment. As a result of encouragement by government policy, freshwater fish pond areas increased to 220,171.3 acres in 2011/2012. Per capita fish consumption of Myanmar was 48 kilograms in 2010/2011. The development of aquaculture production and per capita fish consumption of Myanmar in the last 24 years are described in Table 1.

Table 1. Aquaculture production and per capita fish consumption from 1988 to 2011

Year	Fish pond area (acres)	Production (million viss)	Fish production per acre (viss)	Per capita fish consumption (kg)
1988	6,300	32.52	516	17
1998	49,047	557.98	1,137	18
2008	215,380	3,775.0	1,752	49
2010/11	220,171	5,071.5	2,303	48

* 1viss = 1.6 kg.

Source: Fishery Statistics of Myanmar for 2010/2011 fiscal year, Department of Fisheries

Freshwater fish culture is mostly developed in Yangon region, Ayeyarwady region and Bago region. Currently, over 20 species of fish such as Indian major carps (*Labeo rohita*, *Cirrhinus mrigala* and *Catla catla*), Chinese carps (Grass carp, Silver carp and Bighead carp) and Common carp, tilapias (*Tilapia mossambica* and *Nile Tilapia*), cat fishes (*Clarias* and *Pangasius* spp), *Pantius gonionotus*, Pacu (*Piractus branchyomum*) and Sultan fish (*Leptobarbus hoevenii*) are being commercially cultured. Freshwater fish culture in Myanmar is mainly focused on ensuring food security

and the production surplus is exported to world markets. Eighty percent of the total production of freshwater cultured fish was accounted for by domestic consumption and only twenty percent of the total production was exported in 2010/2011.

Rohu (*Labeo rohita*) is one of the major cultured species and the highest exported cultured fish of Myanmar as a result of its popularity among domestic markets. Rohu is being cultured by most of the freshwater fish farmers, from whom 80 percent of the total amount of freshwater cultured fish production is derived. Amongst ASEAN countries, Myanmar is recognized as one of the highest producers of cultured rohu fish. Because of the high production amount of cultured rohu fish, Myanmar ranked seventh in terms of aquaculture production among Asian countries and was ranked ninth in the world aquaculture production in the 2010 FAO yearbook of fishery and aquaculture statistics. In the 2010 FAO fishery and aquaculture statistics yearbook, the production of Indian major carps was the second highest in aquaculture finfish production.

The DoF has encouraged the establishment of small-scale fish ponds in the countryside as part of its poverty alleviation programme and transferred the culture technique and conducted onsite training among the local farmers. Before 1966, fish farmers grew the carp seed that was collected from the natural waterbodies such as rivers, lakes and reservoirs. The success of induced breeding of Indian major carps through hypophysation technique in Myanmar was achieved with the assistance of Indian scientist Dr. Chaudhuri through an FAO programme in 1966. Hypophysation of fish was done by the use of the pituitary gland till 1992. In recent years induced breeding of fish was successfully conducted by synthetic hormones. Now, most fish farmers can produce fish seeds by themselves because of the dissemination of breeding techniques by DoF and concerned universities in the country. Recently, the DoF and other private hatcheries recognized the need to produce quality seeds for improved growth and disease resistance. Therefore, the DoF has carried out a genetic improvement programme in rohu (*Labeo rohita*) based on the collection of wild breeders from different rivers throughout the country with short-term and long-term planning carried out at Hlawghar Fisheries Station in Yangon region and Kumei Fisheries Station at Mandalay region since 2009. Induced breeding of the new species of freshwater fishes such as *Ompok bimaculatus* (Indian butter catfish), *Catla carpioides* (*nga thine*), *Notopterus notopterus* (feather back), *Cyprinus intha* (*nga phane*), *Trichogaster pectoralis* (snake skin gouramy), *Pangasius bacourti* (striped catfish), *Prochilodus lunatus*, *Osphronemus exodon* (giant gouramy), *Labeo gonius*, *Kuria labeo* (*nga dain*) succeeded at an experimental scale.

Aquaculture is the one of the fastest-growing animal food producing sectors. Pond based aquaculture production systems usually conduct not only breeding, stocking

and feeding of their fish but also planting crops along the dikes or around the pond areas of the holding as secondary sources of income. This type of activity is commonly used in small-scale aquaculture. Because of the increasing engagement of Myanmar households in aquaculture, accessibility of food for these households has improved; thus, it has increased aquaculture's contribution towards the Millennium Development Goals (MDGs).

3. Characteristics of aquaculture holdings in Myanmar

In 2010, the legal status of aquaculture holders in the Republic of the Union of Myanmar based on the results of MCA 2010 was categorized into single household holder and joint household holders (two or more households operating the same aquaculture holding). There were 12,512 household aquaculture holders which included 11,764 single household holders (94.02 percent of the total) and 748 joint household holders (5.98 percent of the total). The highest number of household aquaculture holdings was found in Rakhine state (5,506 holdings or 40.41 percent) followed by the household aquaculture holdings in Ayeyarwady region (2,009 holdings or 16.78 percent). Yangon region was the third highest ranking in terms of the number of household aquaculture holdings (1,654 holdings or 13.22 percent) as shown in Table 2.

When MCA 2003 data and MCA 2010 data of the number of household aquaculture holders are compared, there is an obvious increase in number of total aquaculture households and single household holders but a decrease in number of joint household holders (Figure 1). The growth percentages of total aquaculture households and single household holders were 15.22 percent and 21.62 percent respectively.

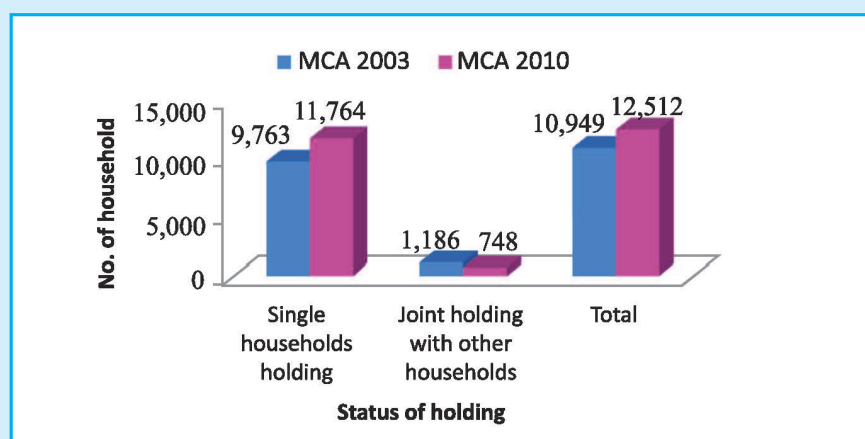


Figure 1. Number of household aquaculture holders in 2003 and 2010

Source: Myanmar Census of Agriculture 2003 and 2010

Myanmar's aquaculture production is dominated by the private sector engaged in the rearing of fish in a pond based culture system. Table 3 describes the total number and area of aquafarms by type of aquaculture activity. A total of 13,594 aquaculture holdings was operated in 2010 in 135,382.87 acres of aquafarms, of which 76.28 percent

of holdings were engaged in pond culture. Rice-cum-fish culture was the second most common type of aquaculture, reaching 10.50 percent of the total holdings, and holdings engaged in hatchery/nursery ranked third at 7.39 percent. However, pen culture was the third highest type of aquaculture (6.96 percent of the total) in terms of physical area of household aquafarms. The order of rank was, therefore, different in terms of number and area of household aquafarms. Cage culture and other types of aquaculture were less developed in Myanmar.

Figure 2 shows that number of aquafarms in pond culture, pen culture, cage culture and other aquaculture increased from 2003 to 2010. However, the number of aquafarms in hatchery/nursery and rice-cum-fish culture showed a decreasing trend from 2003 to 2010. The total number of household aquaculture holdings increased from 2003 to 2010 by 25.2 percent. The majority of production facilities increased in number, except rice-cum-fish, between MCA 2003 and MCA 2010 (Table 4).

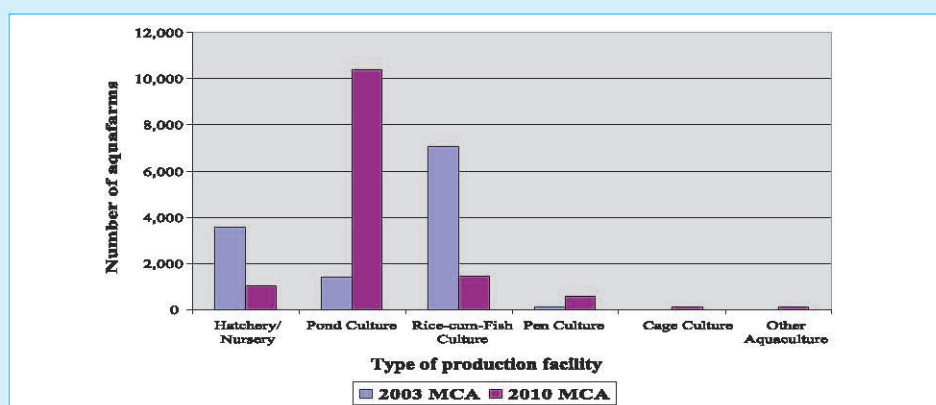


Figure 2. Number of aquafarms by type of production facility in 2003 and 2010

Source: Myanmar Census of Agriculture 2003 and 2010

The total number and area of aquafarms by type of aquaculture and by regions/states of the Republic of the Union of Myanmar is shown in Table 5. Rakhine state, Yangon region and Ayeyarwady region occupied the top three positions for having the highest total number of aquafarms in Myanmar. The pond culture system dominated in all of these three top regions/states. Rice-cum-fish culture system was mostly practiced in Rakhine state, Ayeyarwady and Bago East regions. Larger numbers and areas of hatchery/nursery production systems were found in Ayeyarwady, Bago West, Yangon regions and Rakhine state. Pen culture, cage culture and other aquaculture systems were also mostly developed in Ayeyarwady region and Rakhine state.

The most developed aquaculture systems such as pond culture, rice-cum-fish culture and hatchery/nursery in Myanmar are shown in Figures 3, 4 and 5 according to the size of area of production facility. The majority of culture ponds are between one acre and under three acres and a few are 50 acres and over. However, ponds of 50

acres and over have the largest total physical surface area whereas ponds less than one acre have the smallest total area. Most rice-cum-fish culture operations are between one acre and under three acres and a few are 50 acres and over. The largest total physical surface areas reported for the rice-cum-fish culture is 20 acres and less than 50 acres and the smallest is less than one acre. The majority of hatcheries/nurseries are less than one acre and account for the lowest total physical surface area. Hatcheries/nurseries 50 acres and over are few in number but are operated in the biggest total physical surface area. The top two highest regions/states engaged in pen culture in 2010 were Rakhine state (with 427 aquafarms operating in 5,108.41 sq ft) and Ayeyarwady region (with 82 aquafarms operating in 1,482.53 sq ft). Most cage culture farmers in Myanmar utilized less than 100 sq ft. and this culture system was mostly developed in Ayeyarwady region and Rakhine state.

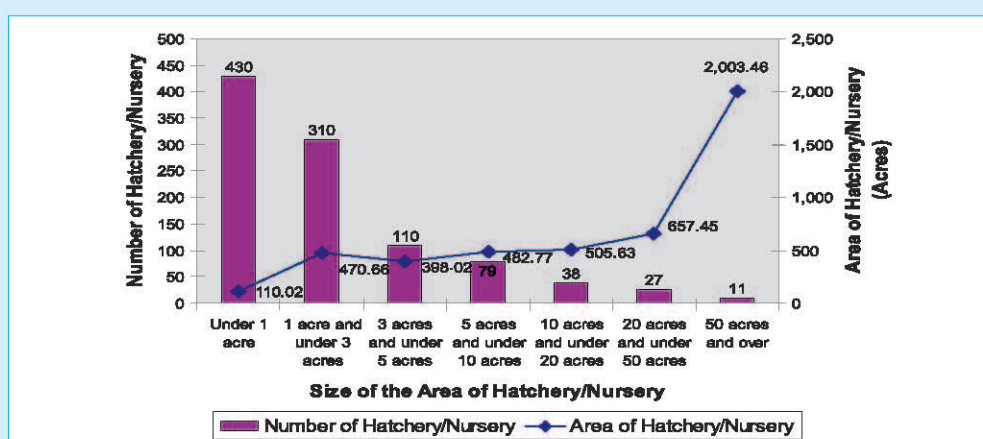


Figure 3. Number and area of hatcheries/nurseries operated by households, by size of the area of the hatchery/nursery, RoUM: 2010
Source: Myanmar Census of Agriculture 2010

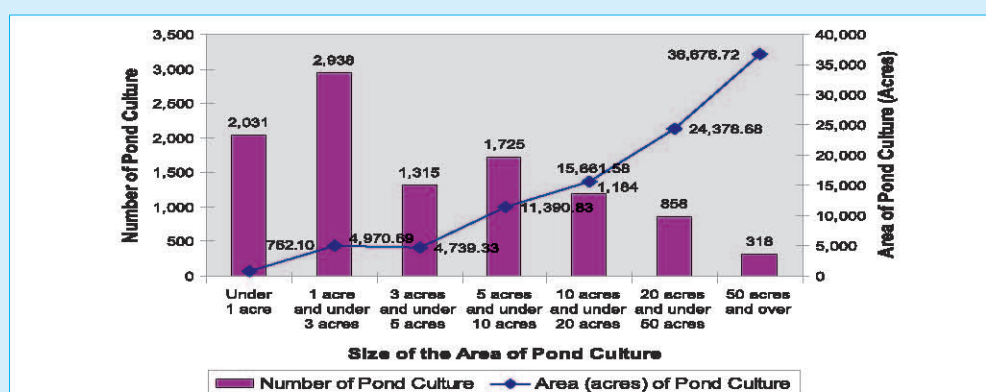


Figure 4. Number and area of pond culture operated by households by size of the area of the pond, RoUM: 2010
Source: Myanmar Census of Agriculture 2010

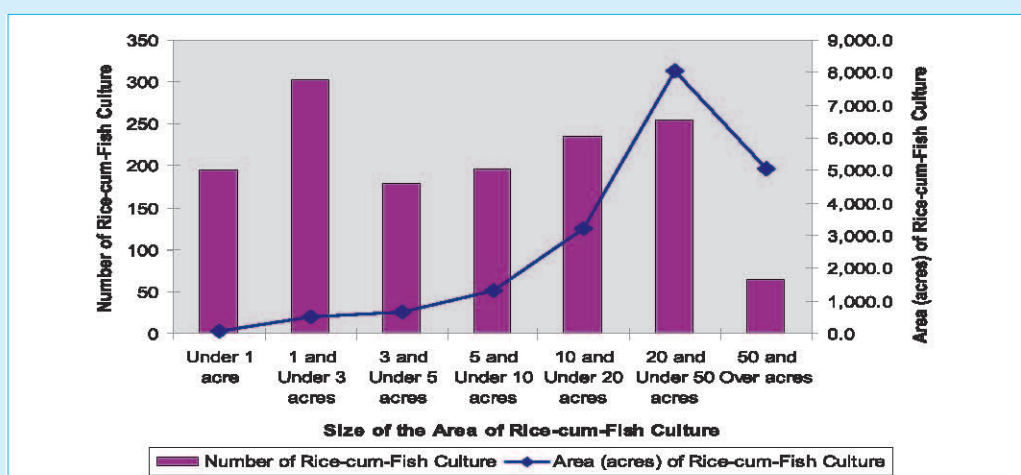


Figure 5. Number and area of rice-cum-fish culture operated by households by size of the area of paddy utilized, RoUM: 2010

Source: Myanmar Census of Agriculture 2010

4. Type of water used in the aquafarms

Myanmar is endowed with freshwater, brackish water and marine fishery resources and aquaculture operations can be found in each of these three different agro-ecological zones. The different types of aquaculture found in each agro-ecological zone are shown in Table 6. The number of aquafarms in the freshwater and brackish water zones increased between MCA 2003 and MCA 2010 but decreased in the marine zone. In MCA 2003 rice-cum-fish (paddy field) was the dominant production type followed by hatcheries/nurseries and ponds. However, this was not the case in MCA 2010.

Based from the MCA 2010 results, more than half or 61.75 percent (8,394) of the total reported number of aquafarm operations were carried out in the freshwater zone whereas 37.08 percent (5,040) of aquaculture farms were found in the brackish water zone and only 1.18 percent (160) of the total number of aquafarms were found in the marine zone. In both freshwater and brackish water areas, pond based culture systems were the major type of aquaculture being carried out (79.99 percent in freshwater) and (75.52 percent in brackish water). Other types of aquaculture (61.88 percent) were mainly practiced in the marine area as can be seen in Table 6. Amongst the different regions and states of the Union of Myanmar, the highest number of aquafarms in the freshwater area was mostly practiced in Yangon and Ayeyarwady regions. Brackish water aquaculture was mainly developed in Rakhine state and Ayeyarwady region. Marine aquaculture was only operated in coastal areas such as in Rakhine state, Ayeyarwady region, Tanintharyi region and Mon state.

5. Production facilities

Ponds accounted for 83 percent of the total number of aquafarms operated by households and occupied 75 percent of the total surface physical area of all production facilities. They also accounted for 89 percent of the total number of production facilities. Paddy fields and pens were other important aquaculture production facilities in 2010 (Figure 6).

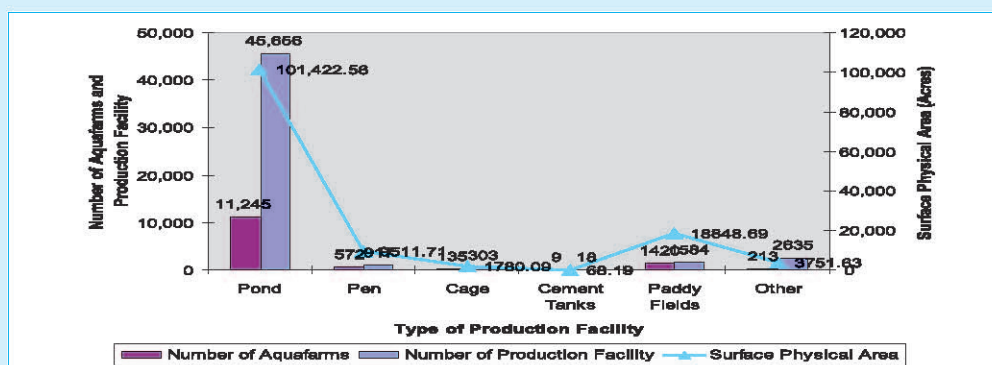


Figure 6. Number and surface physical area of aquafarms operated by households and number of production facilities by type, RoUM: 2010

Source: Myanmar Census of Agriculture 2010

6. Main species cultured

The top five main cultured species in Myanmar were shrimp/prawn (43.53 percent of total), rohu (*nga myit chin*) (25.6 percent of total), Chinese carps (11.65 percent of total), tilapia (7.5 percent of total) and common carp (5.0 percent of total). Shrimp/prawn was mainly cultured in Rakhine state and Ayeyarwady region whereas rohu (*nga myit chin*) was mostly cultured in Yangon, Ayeyarwady, Bago West and Sagaing regions. The Chinese carps (grass carp, silver carp and bighead carp) were the most popular cultured species in Sagaing, Bago West, Mandalay, Yangon and Ayeyarwady regions, whereas common carp was mainly cultured in Sagaing region, Chin state and Bago West region. Tilapia was mostly cultured in Shan East state (Figure 7).

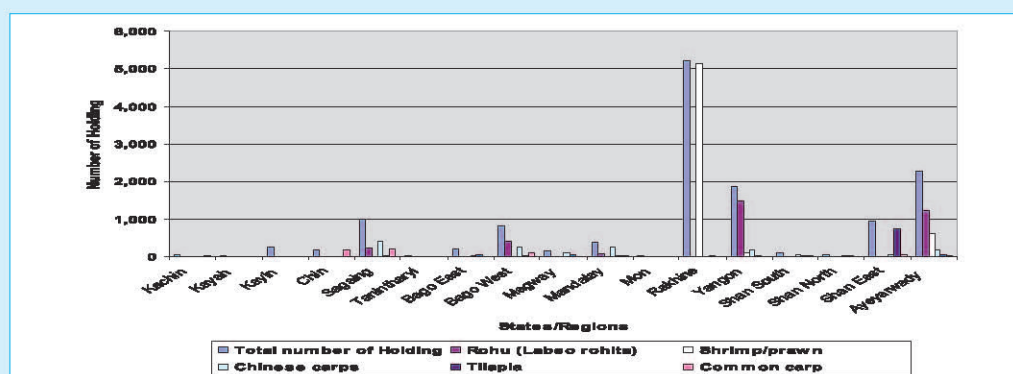


Figure 7. Number of aquafarms operated by households by main cultured species, by region/state, RoUM: 2010

Source: Myanmar Census of Agriculture 2010

Shrimp/prawn was cultured in all types of production facilities except in cement tanks. In culturing shrimp/prawn, 34.5 percent of the aquaculture holdings used pond production facilities, 84.09 percent used pens, 85.19 percent used cages, 90.07 percent used paddy fields, and 76.53 percent used other types of production facility. Most of the aquafarmers used ponds, 34.5 percent cultured shrimp, 30.64 percent cultured rohu, 13.82 percent cultured Chinese carps, 8.63 percent cultured tilapia and 5.89 percent cultured common carps (Table 7).

Except for snakehead and crab, the culture of most of the main cultured aquatic species increased between 2003 and 2010 (Table 8). The number of aquafarms culturing seaweed had the highest rate of growth, followed by eel and other species for the same period.

The main species cultured in 53.4 percent (7,254) of the aquafarms were consumed by the households operating such facilities whereas 11,718 aquafarms (86.2 percent) sold the main species cultured. The number of aquafarms operated by households by means of disposal of main cultured species, by region/state, in 2010 is presented in Table 9. Most of the main cultured species in the aquafarms in the Union of Myanmar were consumed by the households culturing such species as follows: 37.92 percent of the total aquafarms in Rakhine state, 12.88 percent in Yangon region, 12.78 percent in Ayeyarwady region, 11.54 percent in Shan East state and 9.51 percent in Sagaing region. Similarly, most of the aquafarms in these regions/states sold their aqua products (41.81 percent in Rakhine, 17.55 percent in Ayeyarwady, 14.05 percent in Yangon, 6.91 percent in Sagaing and 5.8 percent in Shan East).

Most aquafarms sold their products (89.9 percent) and only 10.12 percent consumed their cultured fish in MCA 2003. However, the number of aquafarms that sold their cultured species decreased in MCA 2010 (55.5 percent), whereas the number of aquafarms that did not sell their cultured species increased in 2010 (Figure 8).

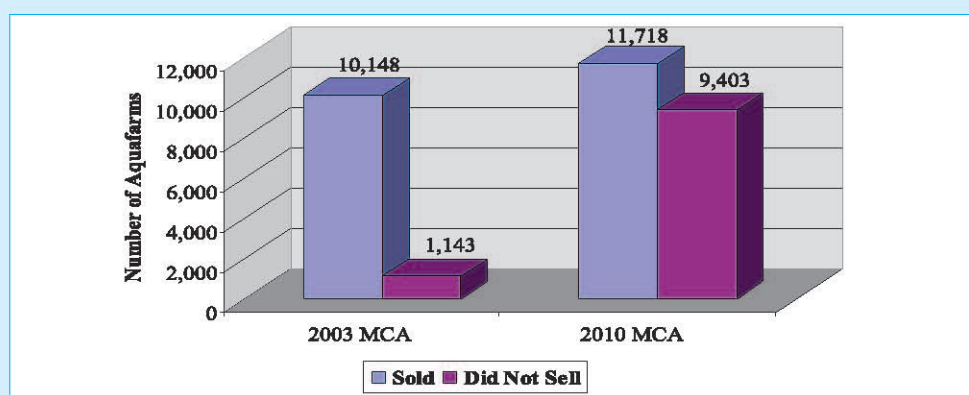


Figure 8. Number of aquafarms operated by households by means of disposal of their products in MCA 2003 and MCA 2010

Source: Myanmar Census of Agriculture 2003 and 2010

In 2010, 800 household-operated aquafarms throughout the country produced fry; 203 from hatcheries/nurseries and 597 from pond culture. Fingerlings were produced from 2,575 aquafarms (403 from hatcheries/nurseries and 2,172 from pond culture). The number of aquafarms producing fry and fingerlings by regions/states is presented in Figure 9. Most of the fry and fingerlings of fish and shrimp/prawn were produced in Rakhine, Yangon, Ayeyarwady, Mandalay, Shan East, Bago (East and West), and Sagaing.

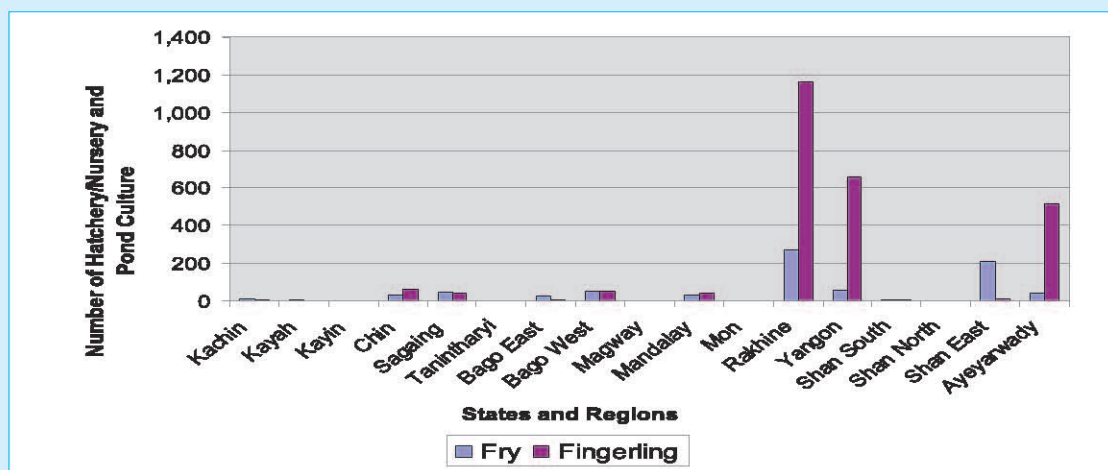


Figure 9. Number of household aquafarms producing fry and/or fingerlings by region/state, RoUM: 2010

Source: Myanmar Census of Agriculture 2010

7. Use of equipment/machinery and buildings

In Myanmar, 4,988 (or 85.1 percent) household aquaculture holdings used water pumps in 2010. The other equipment/machinery heavily used in the aquaculture holdings were tractors (as reported by 151 holdings), vehicles (1,260 holders) and generators (286 holdings). The least used machinery/equipment in the household aquafarms was aerators and feed mixers/mills/extruders (Figure 10). However, it was reported that 1,729 aquaculture holdings used other types of machinery/equipments.

Most of the aquaculture holdings in Myanmar used building/structures like storage buildings, fish processing facilities and other types of buildings. The number of the different types of buildings used in aquaculture holdings in 2010 is shown in Figure 11.

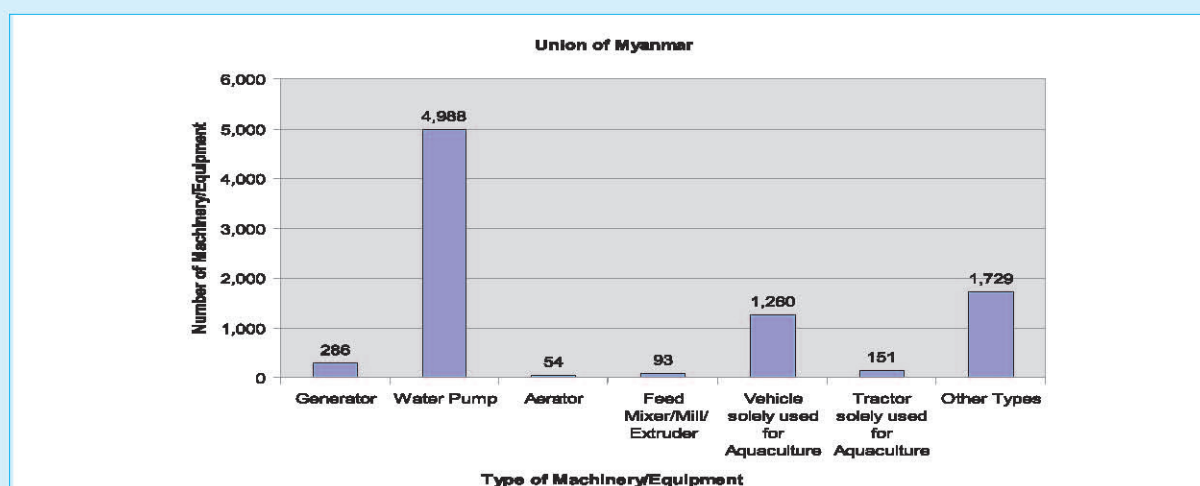


Figure 10. Number of household aquaculture holdings that used machinery/equipment by type of machinery/equipment, RoUM: 2010

Source: Myanmar Census of Agriculture 2010

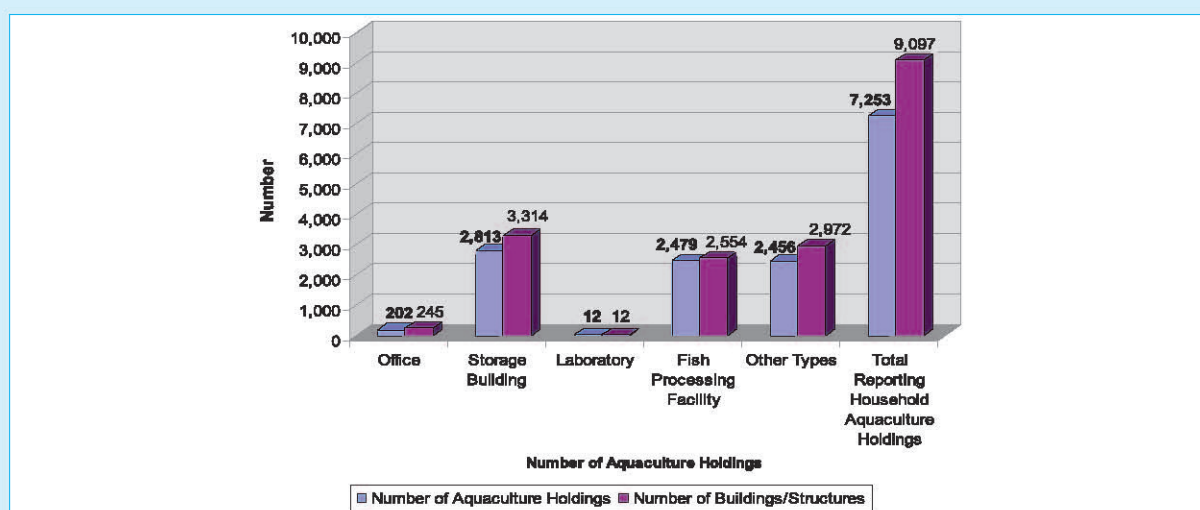


Figure 11. Number of household aquaculture holdings that used building/structure and number of buildings/structures used, by type of building/structure, RoUM: 2010

Source: Myanmar Census of Agriculture 2010

8. Holders and aquaculture labour

Figure 12 shows the number of aquaculture operators by sex and age of operators. The number of aquaculture operators in 2010 totalled 12,491. Most of the operators were males between 40 and 49 years old. Table 10 shows the number of members in household operated aquaculture holdings by sex and age of members, whether involved or not involved in the holdings. Most of the members of the aquaculture households, either engaged or not engaged in aquaculture holdings, were between 16 and 64 years old.

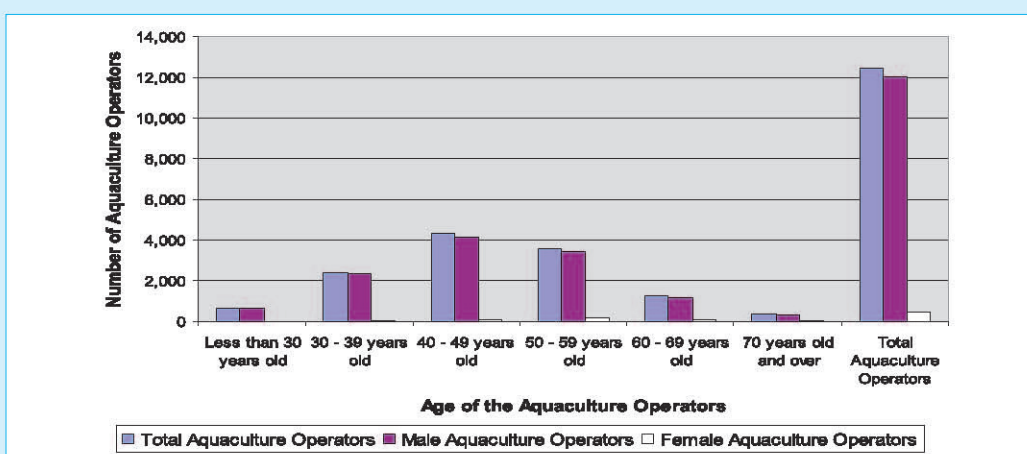


Figure 12. Number of aquaculture operators by sex and age of the operators, RoUM: 2010
Source: Myanmar Census of Agriculture 2010

The number of aquaculture holdings that hired labourers and the number of outside workers in household aquaculture holdings are reported in Table 11 by sex and type of workers in 2010. Sixty-two percent of the household aquaculture holdings hired outside workers, of which 99.6 percent comprised male labourers and 38.1 percent hired female labourers. The total number of outside workers amounted to 58,093, of which 83 percent were males and 17 percent were females. Many of the outside workers worked as aquafarm labourers, and males and females were represented equally in this group. However, the number of outside workers working as “other workers” was greater than the number of aquafarm labourers both male and female. The reason for this was that the “other workers” in the aquaculture holdings worked in different activities inside the holdings such as bookkeeping, accounting, marketing and may not be directly involved in culturing any species. Comparing MCA 2003 and MCA 2010, the total number of workers both male and female increased by 551.6 percent in total and most remarkably the total number of female workers grew by 1,259.4 percent. The number of outside workers increased by 846.3 percent whereas the number of workers in household aquaculture holdings grew by 168.4 percent over the same period (Table 12).

9. Agricultural crops in the aquaculture holdings

The total number of household aquaculture holdings reporting crops planted on their holdings was 3,593 in the whole Union of Myanmar. Most of these were permanent crops, particularly in Yangon, Ayeyarwady, Sagaing, Bago West and Mandalay regions whereas there were a smaller number of annual crops planted in aquaculture holdings in Ayeyarwady region, Rakhine state and Sagaing region (Figure 13). The total number of household aquaculture holdings with annual crops and/or permanent crops planted around the holding increased by 81.92 percent from 2003 to 2010 (Table 13).

10. Conclusions

The sustainable development of aquaculture depends on many factors such as land policy, water quality, fish seed availability, feed supply, weather conditions and, especially, market demand. The total number of aquaculture households increased as did the number of aquafarms with pond culture, cage culture and other aquaculture especially in freshwater and brackish water areas between 2003 and 2010. Of all the cultured aquatic species, seaweeds had the highest rate of growth between 2003 and 2010. The proportion of aquafarms that sold their products decreased from 89.9 percent in 2003 to 55.5 percent in 2010. Along with the increased number of aquaculture households in the Union of Myanmar, the total number of workers both male and female and the planting of annual and permanent crops around the aquaculture household holdings increased between 2003 and 2010.

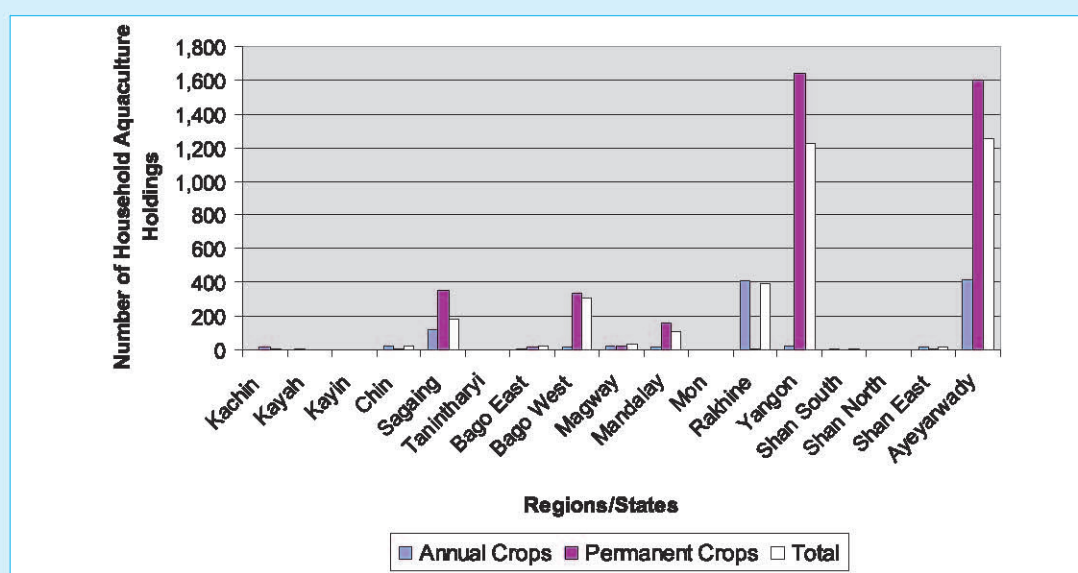


Figure 13. Number of household aquaculture holdings with crops planted on the holdings by crops planted, by region/state, RoUM: 2010

Source: Myanmar Census of Agriculture 2010

11. Recommendations

There are still areas with the potential to increase aquaculture production without compromising environmental quality. Enhancing food security by increasing agriculture production should be encouraged, especially the culture of new freshwater aquatic species for which there is a high market demand in freshwater and brackish water areas and the culture of marine finfish and crustaceans with improved culture techniques in coastal areas and in the sea. Agriculture by-products such as rice bran, peanut cake are

important ingredients of fish feed. Therefore, agriculture-based integrated aquaculture should be expanded to improve the livelihoods and socio-economic development of the rural people.

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Annex

Table 2. Number of household aquaculture holdings reported by legal status, by region/state, RoUM: 2010

Region/State	Legal status of the aquaculture holding					
	Total number of household aquaculture holdings	% to total	Joint holding with other households	% to total	Single household holding	% to total
Union of Myanmar	12,512	100	748	100	11,764	100
Kachin	46	0.37	0	0	46	0.39
Kayah	18	0.14	0	0	18	0.15
Kayin	137	1.09	0	0	137	1.16
Chin	183	1.46	0	0	183	1.56
Sagaing	852	6.81	2	0.27	850	7.23
Tanintharyi	32	0.26	0	0	32	0.27
Bago East	192	1.53	2	0.27	190	1.62
Bago West	692	5.53	8	1.07	684	5.81
Magway	155	1.24	0	0	155	1.32
Mandalay	326	2.61	0	0	326	2.77
Mon	24	0.19	0	0	24	0.20
Rakhine	5,056	40.41	688	91.98	4,368	37.13
Yangon	1,654	13.22	30	4.01	1,624	13.80
Shan South	103	0.82	1	0.13	102	0.87
Shan North	46	0.37	1	0.13	45	0.38
Shan East	897	7.17	6	0.80	891	7.57
Ayeyarwady	2,099	16.78	10	1.34	2,089	17.76

Source: Myanmar Census of Agriculture 2010

Table 3. Number and area of aquafarms operated by households and by aquaculture, RoUM: 2010

Type of aquaculture activity	Number of households		Areas of households (Acres)	
	Total	% to total	Total	% to total
Total holdings	13,594	100	135,382.87	100
Hatchery/nursery	1,005	7.39	4,628.01	3.42
Pond culture	10,369	76.28	98,579.93	72.82
Pen culture	548	4.03	9,422.08	6.96
Cage culture	135	0.99	1,795.24	1.33
Rice-cum-fish culture	1,427	10.50	18,880.8	13.95
Other aquaculture	110	0.81	2,076.81	1.53

Source: Myanmar Census of Agriculture 2010

Table 4. Number of household aquaculture holdings in 2003 and 2010 by type of production facility and growth percentage

Type of production facility	Number of aquafarms		Growth %
	MCA 2003	MCA 2010	
Total holdings	10,859	13,594	25.2
Pond	1,420	11,254	692.5
Pen	89	562	531.5
Cage	8	135	1,587.5
Cement tanks	3	9	200
Paddy fields	7,049	1,421	-79.84
Other	3	213	7,000

Source: Myanmar Census of Agriculture 2003 and 2010

Table 5. Number of aquafarms operated by households and by type of aquaculture, by region/state, RoUM: 2010

Region/State	Type of aquaculture						Total number of aquafarms
	Hatchery/nursery	Pond culture	Rice-cum-fish culture	Pen culture	Cage culture	Other aquaculture	
Union of Myanmar	1005	10369	1427	548	135	110	13594
Kachin	10	38	0	1	0	0	49
Kayah	4	15	0	0	0	0	19
Kayin	116	142	8	1	0	0	267
Chin	84	112	0	0	0	0	196
Sagaing	59	925	0	1	0	0	985
Tanintharyi	1	7	1	1	3	19	32
Bago East	6	149	59	2	0	3	219
Bago West	119	694	1	12	3	1	830
Magway	1	138	13	3	0	0	155
Mandalay	34	340	0	4	0	0	378
Mon	3	23	0	2	1	0	29
Rakhine	126	3,444	1,112	427	49	51	5,209
Yangon	98	1,765	1	5	1	0	1,870
Shan South	3	94	9	3	2	0	111
Shan North	7	39	0	0	1	0	47
Shan East	76	861	0	0	3	0	940
Ayeyarwady	258	1,583	223	86	72	36	2,258

Source: Myanmar Census of Agriculture 2010

Table 6. Number of aquafarms operated by households by type of aquaculture, by type of water used, in MCA 2003 and MCA 2010

Type of production facility	MCA 2003				MCA 2010			
	Fresh water	%	Brackish water	%	Sea water	%	Fresh water	%
Total aquafarms reported	6,451	100	2,343	100	2,070	100	8,394	100
Hatchery/ nursery	2,381	36.91	478	20.40	705	34.06	878	10.46
Pond culture	1,313	20.35	41	1.75	67	3.24	6,714	79.99
Rice-cum-fish Culture	3,893	60.35	1,867	79.68	1,300	62.80	156	1.86
Pen culture	67	1.04	7	0.30	15	0.72	514	6.12
Cage culture	4	0.06	0	0.00	4	0.19	125	1.49
Other aquaculture	3	0.03	0	0.00	0	0.00	7	0.08
							4	0.08
							99	61.88

Source: Myanmar Census of Agriculture 2003 and 2010

Table 7. Number of holdings by type of production facility by principle species cultured, RoUM: 2010

Type of species	Total holding	% to total	Pond	Pen	Cage	Cement tanks	Paddy fields	Other
Total holding	1,3594	100	11,245	572	135	9	1,420	213
Catfish	344	2.53	288	21	5	1	26	3
Snakehead	259	1.90	212	6	1	0	37	3
Common carp	680	5.00	662	6	1	3	5	3
Chinese carp	1,584	11.65	1,554	17	1	2	5	5
Tilapia	1,019	7.50	970	10	2	1	31	5
Sea bass	29	0.21	11	11	5	1	0	1
Rohu (nga myit chin)	3,480	25.60	3,445	12	3	1	19	0
Shrimp/prawn	5,918	43.53	3,880	481	115	0	1,279	163
Crab	13	0.11	9	2	2	0	0	0
Eel	16	0.12	1	0	0	0	12	3
Seaweeds	22	0.16	3	0	0	0	0	19
Other species	230	1.69	210	6	0	0	6	8

Source: Myanmar Census of Agriculture 2010

Table 8. Number of holdings by principle species cultured in MCA 2003 and MCA 2010 and percentage growth

Main species culture	Number of aquafarms		Growth%
	MCA 2003	MCA 2010	
Total holding	10,859	13594	25.19
Catfish	257	344	33.85
Snakehead	418	259	-38.04
Common carp	597	680	13.90
Indian/Chinese carp	4,810	5,064	5.28
Tilapia	384	1,019	165.36
Sea bass	15	29	93.33
Shrimp/prawn	4,367	5,918	35.52
Crab	24	13	-45.83
Eel	1	16	1,500.00
Seaweeds	1	22	2,100.00
Other species	21	230	995.24

Source: Myanmar Census of Agriculture 2003 and 2010

Table 9. Number of aquafarms operated by households by means of disposal of main species cultured, by region/state, RoUM: 2010

Region/State	Means of disposal of main species cultured									
	Consumed	% to total	Sold	% to total	Given away	% to total	Other means of disposal	% to total	Total number of aquafarms reporting	% to total
Union of Myanmar	7,254	100	11,718	100	2,055	100	94	100	13,594	100
Kachin	34	0.47	35	0.30	10	0.49	0	0.00	49	0.36
Kayah	15	0.21	16	0.14	2	0.10	0	0.00	19	0.14
Kayin	126	1.74	119	1.02	5	0.24	19	20.21	267	1.96
Chin	179	2.47	51	0.44	6	0.29	1	1.06	196	1.44
Sagaing	690	9.51	810	6.91	286	13.92	22	23.40	985	7.25
Tanintharyi	25	0.34	30	0.26	3	0.15	0	0.00	32	0.24
Bago East	93	1.28	147	1.25	11	0.54	0	0.00	219	1.61
Bago West	318	4.38	662	5.65	92	4.48	2	2.13	830	6.11
Magway	91	1.25	149	1.27	16	0.78	0	0.00	155	1.14
Mandalay	103	1.42	285	2.43	36	1.75	5	5.32	378	2.78
Mon	11	0.15	23	0.20	2	0.10	0	0.00	29	0.21
Rakhine	2,751	37.92	4,899	41.81	502	24.43	4	4.26	5,209	38.32
Yangon	934	12.88	1,646	14.05	500	24.33	5	5.32	1,870	13.76
Shan South	81	1.12	85	0.73	22	1.07	0	0.82	111	0.82
Shan North	39	0.54	24	0.20	1	0.05	2	0.35	47	0.35
Shan East	837	11.54	680	5.80	424	20.63	21	6.91	940	6.91
Ayeyarwady	927	12.78	2,057	17.55	137	6.67	13	16.61	2,258	16.61

Source: Myanmar Census of Agriculture 2010

Table 10. Number of members in household-operated aquaculture holdings whether involved or not involved in the holdings by sex and age of members, RoUM: 2010

Gender	Total members	% to total	10 - 15 years old	% to total	16 - 64 years old	% to total	65 years old and over	% to total
Involved in aquaculture holding/age of members								
Total	32,380	100	1,482	100	29,737	100	1,161	100
Male	21,122	65.23	1,038	70.04	19,306	64.92	778	67.01
Female	11,258	34.77	444	29.96	10,431	35.08	383	32.99
Not involved in aquaculture holding/age of members								
Total	1,4143	100	5,655	100	7,327	100	1,161	100
Male	5,811	41.09	2,854	50.47	2,511	34.27	446	38.42
Female	8,332	58.91	2,801	49.53	4,816	65.73	715	61.58

Source: Myanmar Census of Agriculture 2010

Table 11. Number of household aquaculture holdings that hired labourers and number of outside workers in the household aquaculture holdings by sex and type of workers, RoUM: 2010

Type of workers	Total	% to total	Male	%	Female	%
Number of household aquaculture holdings						
Total	12,668	100	9,724	100	2,944	100
Manager	128	1.01	110	1.13	18	0.61
Aquafarm labourers	7,099	56.04	5,762	59.26	1337	45.41
Other workers	5,441	42.95	3852	39.61	1,589	53.97
Number of outside workers						
Total	58,093	100	48,272	100	9,821	100
Manager	180	0.31	154	0.32	26	0.26
Aquafarm labourers	23,974	41.27	19,933	41.29	4,041	41.15
Other workers	33,939	58.42	28,185	58.39	5,754	58.59

Source: Myanmar Census of Agriculture 2010

Table 12. Number of household aquaculture holding by type of workers and sex in 2003 and 2010 and growth percentage

Type of workers	MCA 2003			MCA 2010			Growth%		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
Total	10,859	9,920	939	70,761	57,996	12,765	551.6	484.6	1,259.4
Number of household aquaculture holdings	4,720	4,357	363	12,668	9,724	2,944	168.4	123.2	711.0
Number of outside workers	6,139	5,563	576	58,093	48,272	9,821	846.3	767.7	1,605.0

Source: Myanmar Census of Agriculture 2003 and 2010

Table 13. Number of aquaculture holding by type of crops planted around the holding in 2003 and 2010 and growth percentage

Type of crops planted	Number of aquaculture holding by crops planted around the holding		Growth%
	MCA 2003	MCA 2010	
Total	1,975	3,593	81.92
Annual crops	341	1,095	221.11
Permanent crops	1,634	4,176	155.57

Source: Myanmar Census of Agriculture 2003 and 2010

**The Republic of the Union of Myanmar
Ministry of National Planning and Economic Development
Central Statistical Organization**

**Multi-Economic Activities of Agricultural
Households in Myanmar**

Marlar Aung

Abstract

The Myanmar Census of Agriculture 2010 (MCA 2010) is a remarkable achievement that provides reliable baseline data from which changes in agricultural activities can be measured. It gives an analysis of all the households engaged in agricultural activities. It should enable the concerned authorities to formulate policies and standards for development and harmonization of agricultural activities in Myanmar for years to come. The MCA 2010 presents the results of the survey on households, land utilization, economic activities, agricultural population and their demographic characteristics etc. In short, MCA 2010 should be able to serve as a technical arm and guidelines for this sector.

We hope that this analysis will ultimately be beneficial for agriculture households and for any future agriculture sector planning activities. The views expressed in this paper are those of the author and should not be attributed to CSO.

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Multi-economic activities of agricultural households in Myanmar¹

Marlar Aung²

1. Introduction

Agriculture is the dominant sector of the Myanmar economy. In terms of national production, the agricultural sector contributes as much as 40 to 50 percent of total output.

Myanmar conducted censuses of agriculture in 1993, 2003 and 2010. In this paper, the multi-economic activities of the agricultural households will be described, based on the findings of these censuses and other statistical publications.

2. Food security in Myanmar

Myanmar is one of the most populous countries in Southeast Asia, with about 59.7 million inhabitants in 2010, of which less than one-third (about 18.3 million people) live in urban areas. The country is rich in land and water resources and there are wide variations in climate and geography. There are over 60 crops planted in the country. Of the ten major crops, paddy is the most important.

Food security reports based on national socio-economic data present information on the dietary energy needs of the population, usually measured in terms of the minimum dietary energy requirement (MDER). The average daily dietary energy requirement refers to the average values in terms of acceptable weight-for-height and physical activity levels. Table 1 presents some undernourishment indicators for Myanmar. MDER is used as the cut-off point for estimating the prevalence of food deprivation.

¹ This paper was presented in the National Data Dissemination Seminar on Myanmar Census of Agriculture 2010 in Myat Taw Win Hotel, Nay Pyi Taw on 5-6 November 2012.

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Table 1. Food consumption, needs and undernourishment indicators, SOFI 2010

Myanmar food security indicators	1990/1992	2005/2007	Percentage change
Population (million)	41.7	48.7	17.0
Proportion of undernourished population (percentage)	47.0	16.0	-31.0
Number of undernourished population (million)	19.6	7.8	-11.8
Food needs (Kcal/p/d)			
Minimum dietary energy requirement (MDER)	1,740	1,800	4.0
Average dietary energy requirement (ADER)	2,200	2,290	4.0
Intensity of food deprivation (Kcal/p/d)	310	230	-26.0
Food consumption			
DES (Kcal/p/d)	1,840	2,240	25.6
Protein (gm/p/d)	10.0	11.4	13.0
Fats (gm/p/d)	18.3	21.8	18.0

Source: FAO Food security statistics Webpage (faostat.fao.org)

According to Table 1, the population of the country increased steadily (17 percent) between the periods of 1990/1992 and 2005/2007. The proportion of the undernourished population and the number of the undernourished population decreased sharply. MDER and ADER rose gradually. Intensity of food deprivation declined considerably. Food consumption relating to dietary energy supply, protein and fats increased significantly, by 25.6 percent, 13 percent and 18 percent respectively. Thus Myanmar's food consumption is definitely improving.

Myanmar should be able to produce surplus food and indeed there is a lot of food in the market. The movement of the food poverty line though does not depend on food production, but on the national poverty level. To put it simply, there is a great quantity of food in all of the markets in Myanmar, but people do not have enough money to spend on necessary food items to meet the required level of dietary energy. In the long run, the trend is expected to fall steadily.

Concerning MDER and ADER compared to DEC in Myanmar, Table 2 gives complete information in detail.

Table 2. MDER and ADER compared to DEC

No.	Myanmar/Urban/ Rural	MDER (minimum dietary energy requirement)	DEC (dietary energy consumption)	ADER (average dietary energy requirements)
1.	Myanmar	1,836	1,990	2,355
2.	Urban	1,848	1,840	2,375
3.	Rural	1,831	2,025	2,347

At national level, the DEC of the Myanmar population was eight percent higher than MDER (1,990 versus 1,836), but about 15 percent less than the ADER (1,990 versus 2,355). This indicates that there is a need to bridge the gap by increasing food supply and food access in Myanmar. The same trend goes on at the rural level, but there is little difference at urban level. The DEC is a little lower than the MDER at urban level and much less than the ADER (1,840 versus 2,375). DEC is much higher than the MDER at rural level (1,831 versus 2,025) and it is lower than the ADER. These are important findings extracted from the Myanmar Food Security Statistical Analysis, 2006.

3. Economic activity by household heads

All household heads with agricultural holdings are engaged predominantly in their own agricultural holdings (over 4 million heads), but forestry-related activities are important too (over 1 million) (Table 3). Male household heads are better represented than female household heads in every economic activity.

Although not shown in Table 3, work in forestry-related activities is as important as work on the agricultural holding in some regions/states such as Kachin, Chin, that is in the regions close to forests.

Table 3. Total heads of households that worked during the past 12 months by sex, MCA 2010

Economic activity of the household head	Male heads	Female heads	All heads
Worked in own agricultural holdings	4,163,473	540,396	4,703,869
Worked in other agricultural holdings	748,186	79,964	828,150
Engaged in fishing / aquaculture	155,073	1,615	156,687
Worked in forestry-related activities	1,075,621	80,031	1,155,652
Worked in non-agricultural, fishing / forestry industry	404,832	56,415	461,247
Total	4,310,925	564,878	4,875,803
Non-economic activity	293,150	250,807	543,957

4. Economic activity by size of area and crop holdings

Table 4 gives details of the number of crop holdings, the size of crop holdings and the number of parcels.

According to Table 4, it can be concluded that:

- (a) The area of crop holdings of 10 acres and under 20 acres was the largest in total, 9.49 million acres, in 2010 comprising 727,458 crop holdings, thus ranking fourth out of six in terms of number of holdings.
- (b) The number of crop holdings of 1–3 acre-group is largest, followed by crop holdings of 5–10 acres and 3–5 acres, which occupy second and third place respectively.
- (c) The number of parcels of 5–10 acres is the largest, with 2.21 million parcels, followed by parcels of 1–3 acres and 3–50 acres.

There are important differences across regions/states but these are not shown in the table.

Table 4. Number and area of household crop holdings during the past 12 months, MCA 2003 and 2010

Size of area of the crop holdings	Number of crop holdings		Area of crop holdings		Number of parcels	
	2003	2010	2003	2010	2003	2010
Less than 1 acre	471,782	247,584	144,048	111,711	575,452	257,471
1 acre and under 3 acres	766,422	1 345,024	1,429,511	2,338,996	1,483,392	1,598,600
3 acres and under 5 acres	635,806	1,102,363	2,409,183	3,959,043	1,362,840	1,580,935
5 acres and under 10 acres	796,439	1,336,222	5,515,205	8,805,156	1,877,209	2,209,899
10 acres and under 20 acres	504,426	727,458	6,811,096	9,488,066	1,294,639	1,405,431
20 acres and under 50 acres	157,945	212,231	4,430,682	5,750,299	445,212	474,006
50 acres and over	5,332	15,789	452,008	1,161,825	17,001	35,245
No land	6,364					
Total	3,344,516	4,986,671	21,191,733	31,615,096	7,055,745	7,561,587

In 2003, holdings of 5 acres and under 10 acres outnumbered all other groups, with holdings of 1 acre and under 3 acres being in second place. In 2010, these positions were exactly reversed. As for area of crop holdings in 2003 and 2010, holdings of 10 acres and under 20 acres and holdings of 5 acres and under 10 acres occupied

the first and the second position respectively in both years. Similarly, in 2003 and 2010, in relation to number of parcels, the holdings of 5 acres and under 10 acres and holdings of 1 acre and under 3 acres were in first and the second position respectively in both years. At country level, the figures for the number of holdings, the area of crop holdings and the number of parcels increased considerably between 2003 and 2010.

5. Land utilization by number and area of parcels

In the agricultural sector, the type of land of the parcel plays key role in agricultural statistical analysis. Land type signifies crop pattern and land use. For example, *ya* is usually situated on hilly areas and *dhani* is closely related to tidal forests. Table 5 shows the number and area of parcels.

Table 5. Number and area of parcels for each type of land, MCA 2003 and 2010

Type of land of parcel	Number of parcels		Number of parcels		Area of parcels (acres)		Area of parcels (acres)	
	2003	% of total	2010	% of total	2003	% of total	2010	% of total
Paddy	2,241,357	31.77	3,736,992	49.42	11,808,377	55.72	18,312,892	57.92
Ya	1,297,442	18.39	2,531,264	33.48	6,169,514	29.11	9,231,972	29.20
Kaing	291,853	4.14	498,884	6.60	911,165	4.30	1,361,087	4.31
Garden	393,034	5.57	467,690	6.19	752,891	3.55	1,247,497	3.95
Dhani	17,230	0.24	21,984	0.29	40,892	0.19	37,014	0.12
Rubber	20,958	0.30	86,663	1.15	151,029	0.71	612,655	1.94
Other land	2,793,871	39.60	218,108	2.88	1,357,845	6.41	811,960	2.57
Total	7,055,745	100.00	7,561,585	100.00	21,191,713	100.00	31,615,077	100.00

Today families in different parts of Myanmar vary so markedly in composition and function that it is impossible to make a simple statement about changes in the agricultural sector without considering them. At any rate, changes are taking place. In fact, changes relating to parcels depend on the size of family, such as whether it is a traditional nuclear family or an extended family. According to Table 5, every type of land parcel except *dhani* increased in number and area in 2010 compared to 2003. Although the number of parcels on *dhani* land increased the total area decreased. In 2010, there were 0.56 million more parcels compared to 2003 and the total area of the parcels increased by 10.4 million acres over the same time period. The most impressive change was for paddy. In 2010 there were 1.5 million parcels and 6.5 million acres more than in 2003.

The data in Table 5 shows clearly that, importantly:

- (a) The number of parcels (3.74 million) and the area of parcels (18.31 million acres) for paddy in 2010, surpassed the number and area of all other types of land.
- (b) *Ya* holds the second position with 2.53 million parcels and 9.23 million acres, followed by *kaing* and garden in third and fourth position respectively.

6. Number of parcels and area by sex of household heads

Table 6 allows us to make a comparison between male-headed and female-headed crop holdings. The total number of parcels was 7.56 million in 2010 and 7.06 million in 2003 with the vast majority of crop holdings being headed by males (6,840,850). Similarly, the area of parcels in 2010 increased by 10.43 million acres compared to 2003 with male-headed crop holdings accounting for the vast majority (28,961,077 acres). Male-headed households also had a larger average area per parcel.

Table 6. Number and area of parcels by the sex of the head of household in MCA 2003 and MCA 2010

All crop holdings	Male-headed crop holdings	Female-headed crop holdings	Total
2010			
Number of parcels	6,840,850	720,735	7,561,585
Total area of parcels (acres)	28,961,077	2,654,020	31,615,097
Average area per parcel (acres)	4.23	3.61	4.18
2003			
Number of parcels	-	-	7,055,745
Total area of parcels (acres)	-	-	21,191,714
Average area per parcel (acres)	-	-	3.00

7. Number and area of parcels by economic activity

In Table 7 the number and area of parcels of all crop holdings are given for main types of land utilization.

Table 7. Number and area of parcel by the main land use of the parcel in MCA 2003 and MCA 2010

Main land use of parcel	All crop holdings (2003)		All crop holdings (2010)	
	Number of parcels	Area of parcels	Number of parcels	Area of parcels
Annual crops	6,608,174	26,771,743	6,752,552	29,005,079
Permanent crops	804,666	1,056,479	640,868	2,014,047
Combined annual and permanent crops	-	-	86,854	393,242
Fallow	-	-	9,063	23,897
Livestock/Poultry	-	-	598	1,172
Aquaculture	-	-	353	1,616
Other land use	-	-	71,298	176,040
Total	7,412,840	27,828,222	7,561,582	31,615,097

In 2003, the total area of all land holdings was 27.82 million acres with the area under annual crops accounting for the vast majority. Both the number and area of parcels increased in 2010. There were 6.8 million parcels amounting to 31.62 million acres of parcels in the MCA 2010 and again the number and the area under annual crops accounted for the vast majority of this change, followed by permanent crops. On the whole, land utilization in the country significantly improved.

8. Irrigated area

Myanmar has been striving to use every available water resource. Irrigation systems are essential for multi-cropping as well as for the development of the agriculture sector in general. Comparing crop cultivation in the MCA 2010 with that of MCA 2003, significant progress is seen. The total area irrigated in 2003 was 3,432,852.52 acres and 5,772,902 acres in 2010.

Table 8. Number and area of irrigated of parcels used by the households in MCA 2010

Size and area of the irrigated parcels	Number of irrigated parcels	Area of irrigated parcels (acres)
Less than 1 acre	209,699	95,660
1 acre and under 3 acres	736,017	1,217,740
3 acres and under 5 acres	364,601	1,294,255
5 acres and under 10 acres	270,051	-
10 acres and under 20 acres	84,516	1,060,488
20 acres and under 50 acres	13,387	339,890
50 acres and over	478	36,647
Total	1,678,749	5,772,902

As can be seen in Table 8 the first four groups of parcels occupy the top four positions in terms of the number of irrigated parcels, with parcels 1 acre and under 3 acres in premier position. However, in terms of area of irrigated parcels, although the top four positions are still occupied by the first four groups, parcels of 3 acres and under 5 acres take over the premier position.

9. Households and land holdings in agriculture

The censuses conducted in 1993 and 2003 use the concept of an agricultural holding as the statistical unit for collecting data on agricultural production. The definition of a holding proposed by FAO has been adopted by most countries, including Myanmar. The holding is similar to the concept of the establishment used in industrial and other economic statistics. The difference is location.

In Myanmar, a holding is understood to be operated by two or more persons or households. According to the census' findings, the number of households has increased to a considerable extent and the size of land holdings or the number of separate parcels has decreased. Holdings may be operated by a holder whose main occupation is not in agriculture, for example a teacher or civil servant may have a holding that they operate only at weekends and during the holidays.

Table 9 presents the distribution of agricultural households by various demographic characteristics.

Table 9. All households with agricultural holdings by various demographic characteristics, 2010

Particulars	Male	Female	Total
Sex of the household members (Myanmar)	12,560,995	13,159,912	25,720,907
(a) Urban	274,392	287,234	561,626
(b) Rural	12,286,603	12,872,678	25,159,281
Household heads who are considered literate	4,604,074	815,685	5,419,759
Household members who are considered literate	11,916,996	12,520,898	24,437,894

Source: MCA 2010

Note: Being literate here means they have acquired literacy skills like reading, writing and can understand simple messages both in English and in the Myanmar language.

People who live in rural areas of Myanmar make up 75 percent of the population. At present, the government has been giving special attention to promoting the living standard of rural people and making progress in the agriculture sector. For this purpose, four tasks for rural development have already laid down, namely water supply by means of irrigation, using high-yield variety crops, extended use of organic and inorganic fertilizer, and extended use of farm machinery. These tasks are being implemented in

harmony to boost agricultural production. Today, rural Myanmar is changing; the past and the present are quite different. But it is still the agriculture sector that determines the whole social and economic life of people in a country such as Myanmar.

In 1993 and 2003, the total area of household-based land holdings was 16.78 and 21.19 million acres respectively (Table 10). This trend continued and in 2010, the total area of household crop holdings was 31.62 million acres (Table 11).

Table 10. Area of household-based land-holdings by size of holding, 1993 and 2003

Size of land holdings	Area of holdings in acres			
	1993	(%)	2003	(%)
Union total	16,781,632.83	100.00	21,191,713.60	100.00
Under 1 acre	91,380.79	0.54	144,047.61	0.68
1 acre and under 3	1,300,101.08	7.75	1,429,510.90	6.75
3 acres and under 5	2,131,170.12	12.70	2,409,183.40	11.37
5 acres and under 10	5,292,857.78	31.54	5,515,205.34	26.03
10 acres and under 20	5,506,925.25	32.82	6,811,095.95	32.14
20 acres and under 50	2,379,289.92	14.18	4,430,661.97	20.91
50 acres and over	79,907.89	0.48	452,003.43	2.13

Source: MCA 2003

Table 11. Number and area of household crop holdings and parcels in MCA 2010

Size of the area of crop holdings	Numbers of crop holdings	Area of crop holdings	Numbers of parcels
Union total	4,986,672	31,615,097.56	7,561,585
Less than and 1 acre	247,584	111,711.05	257,471
1 acre and under 3	1,345,024	2,338,996.04	1,598,600
3 acres and under 5	1,102,363	3,959,043.18	1,580,935
5 acres and under 10	1,336,222	8,805,156.43	2,209,899
10 acres and under 20	727,458	9,488,066.19	1,405,431
20 acres and under 50	212,231	5,750,299.39	474,006
50 acres and over	15,789	1,161,824.83	35,245

Source: MCA 2010

10. Main source of income of the holders' household

As could be expected more than 2.9 million holdings depended on agriculture as the main source of income (81.03 percent), followed by non-agricultural activities except

fishing (10.78 percent), non-agricultural family operated business (8.71 percent). Of the 3.38 million holdings in the country, 2.44 million holdings (72.1 percent) produced mainly for sale whereas 27.9 percent of holdings produced mainly for home consumption.

In Myanmar, farming activities are undertaken predominantly by rural households. These households are both producers and consumers and an understanding of how production and consumption decisions are made is important for devising policies that will help to increase output as well as deal with the government's main aims for the agriculture sector, namely to produce surplus paddy, to achieve sufficiency in edible oil, and to boost beans and pulses production for export and extend the cultivation of industrial crops.

In the agricultural export sector, the export of beans and pulses has outstripped that of rice and rice products for a long time (Table 12).

Table 12. Export of rice and rice products and beans and pulses

No.	Commodity	Unit	2005/2006	2006/2007	2007/2008	2008/2009	2009/2010
1.	Rice and rice products	K	214	18	552	1,112	1,391
		MT	180	15	358	666	818
2.	Beans and pulses	K	1,876	3,498	3,463	4,069	5,063
		MT	865	1,156	1,141	1,451	1,232

Note: K = Kyat million, MT = Thousand metric ton

In 2010 Myanmar had a total crop sown area of 57.73 million acres; current fallows of 0.58 million acres, net area sown of 29.59 million acres, cultivable waste other than fallows 13.86 million acres. Rice production is being intensified by all means so as to meet the requirements of increasing local consumption and the international market demand. Traditionally, paddy was grown once a year, mainly as monsoon paddy. With the introduction of the summer paddy programme in 1992/1993, rice is being produced throughout the year. As mentioned in the MCA 2003, three industrial crops were included in the list of the ten major crops. This is a good sign and will be a great aid to the development of the industrial sector, especially when industrial zones are dotted all over the country.

Credit can serve as a means of financing income-generating activities. It has particular importance for agricultural households given the time lag between sowing and harvesting. However, credit can lead to unsustainable debt loads.

The data presented below attempts to shed light on credit access.

Table 13. Access to credit

No.	Particulars	Year	Head of household		
			Male	Female	Total
1.	Population percentage of agriculture	2005	38.1	37.8	38.1
		2010	33.2	32.0	33.0
2.	Population percentage of non-agriculture	2005	15.0	14.8	15.0
		2010	11.0	11.4	11.1

Source: Poverty Profile, June 2011

The table presents data on the proportion of households, whose main economic activity is agriculture, having received a loan between the periods of May-October for agricultural activities. It is important to note that this table combines recipients of both formal and informal credit institutions.

About 33 percent of agricultural households received a loan for agricultural activities in 2010, compared with about 38.1 percent in 2005. For the non-agriculture sector, only about 11.1 percent of households took out a loan to finance business activities in 2010, compared with about 15.0 percent in 2005. Note that the data are collected before the reporting year.

In addition to credit access, loan size and source need to be taken into account. Very small loans are unlikely to translate into significant impact on household income or consumption. Loan source, naturally is relevant in that it sheds light on repayment terms and conditions. Sources of loan or credit are government or private banks, some agencies, local credit unions, NGOs and international organizations. Other sources of loan are relatives, friends, employer, landlord, traders, brokers, pawnshops and money lenders. It is significant that the average loan size, in particular of the poor, is about 170,000 kyat, and the loan size of the poor has increased quite substantially between 2005 and 2010. The size of loan for both the poor and non-poor increased moderately. Interestingly, there are not large differences between poor and non-poor household in accessing informal credit. Just over 51 percent of all credit in 2010 came from informal lenders.

11. The 2010 Myanmar Census of Agriculture

The agriculture census is the only data collection programme that conducts an integrated programme of data collection and dissemination on agricultural activities. The agriculture census is inventory of basic factors used for agricultural production, which consists of source of manpower, number and area of land parcels, area by land use, by crop, by type of livestock, machinery and equipment used etc. The tables expressed in

the MCA 2010 are complete enough to provide the legal status of holder, tenure arrangements on production factors and the other factors.

Table 14. All households with agricultural holdings, 2010

Sr. No	Age-group	Male	Female	Total
1.	Less than 10 years old	1,709,597	1,683,150	3,392,742
2.	10–19 years old	2,663,464	2,624,786	5,288,250
3.	20–29 years old	2,329,916	2,364,662	4,694,578
4.	30–39 years old	1,809,664	1,978,978	3,788,642
5.	40–49 years old	1,623,062	1,830,926	3,453,988
6.	50–59 years old	1,302,920	1,412,825	2,715,745
7.	60 years old	1,122,373	1,264,587	2,386,960
	Total	12,560,996	13,159,914	25,720,905

According to Table 14, the total population of households with agricultural holdings was 25.72 million in 2010 comprising 12.56 million males and 13.16 million females. These figures are further broken down by age groups. In Myanmar society, with regard to agricultural activities, men generally undertake the heavy work and women do light jobs such as caring for crops, weeding, caring for animals. The bulk of the agricultural work during the rainy season falls to women. Women typically work longer hours than men. The age-groups 10–19 and 20–29 tend to do most of the work in an agricultural economy.

A very important item is household consumption pattern. In Myanmar, more people are being fed adequately today than ever before; but it is also true that the number of the poor and malnourished have risen. Some observers have noted that Myanmar children in rural areas are in need of vitamins, protein, carbohydrate, iron etc. Table 15 gives basic food consumed by Myanmar households in rural area.

Among daily consumed food items, rice and other cereals are first, followed by any kind of vegetables and then fish and seafood items. Potatoes and other root crops, edible dry beans/pulses and any kind of meat are in descending order under weekly food items. Monthly consumed food items are meat and fruit items. In general, potato, pulses, vegetables, fish and edible nuts are major food items generally consumed by all rural households.

Table 15. Number of households engaged in agricultural holdings that reported basic food consumed during the past 12 months (2010)

Food items	Daily	Weekly	Monthly	Seldom
Rice and other cereals	5,411,162	2,821	2,505	2,497
Potato and other root crops	509,761	2,308,408	948,056	1,635,452
Edible dry beans and pulses	653,810	2,413,965	930,457	1,412,569
Any kind of vegetables	3,592,576	1,065,425	153,433	607,338
Any kind of fruits	323,470	1,317,900	1,174,705	2,562,899
Any kind of edible nuts	206,572	773,603	834,141	3,303,820
Any kind of meat	154,199	1,914,388	1,318,830	2,018,598
Any kind of fish and other seafoods	1,538,470	1,307,191	705,579	1,785,761
Total households	5,414,587	3,841,671	2,881,859	4,050,913

In 2003, there were 150,000 male heads of households who never attended school. In 2010, there were 654,000 male heads who never attended school. The figures for female heads of household increased to from 41,305 in 2003 to 218,567 in 2010. However, in general more female and male heads are better educated in 2010 than in 2003 (Table 16).

Table 16. Total heads of the households with agricultural holdings by sex and educational attainment at Union level 2003 and 2010

No.	Education attained by the household	Male heads		Female heads		All heads	
		2003	2010	2003	2010	2003	2010
1	Never attended school	150,435	646,805	41,305	218,567	197,140	865,372
2	Primary school level	1,386,409	2,534,357	242,404	411,611	1,628,813	2,945,968
3	Middle school level	445,530	762,703	47,103	51,453	492,633	814,156
4	High school level	106,889	190,215	11,311	10,024	118,200	200,239
5	High school graduate		38,813		3,269		42,082
6	College undergraduate	22,351	5,957	2,854	674	25,205	6,631
7	College graduate	16,796	36,868	3,025	3,973	19,821	40,841
8	Post graduate		1,363		228		1,589
9	Other education attained	719,016	386,993	149,088	115,887	868,104	502,880
	Total	2,847,426	4,604,074	497,090	815,686	3,349,916	5,419,758

Rapid technological change is taking place everywhere. Education and technology go hand in hand. Education is one of the key features of modern times. The development of human resources is mainly based on the quality of education. As seen in the table, although there are great improvements, the increased number of household heads who had never attended school in 2010 indicates that serious consideration needs to be given for the future agriculture sector.

12. The labour force in the agriculture sector

12.1 1993 and 2003 census

The MCA 2003 described labour force participation in detail by a number of variables. Labour can be classified as family labour and hired labour. Most households engaged in agricultural services cannot meet their demand for labour by using family labour only. Hired labour is a must. Table 17 shows the situation of hired labour. Hired labour based on type of employment is divided into full time, part-time, seasonal and occasional.

According to Table 17, the proportion of female hired labour was greater than that of male hired labour for all types of employment, 69.3 percent versus 30.7 percent, although the difference in proportion decreased somewhat in the case of non-household based employment (58.4 percent versus 41.6 percent).

Table 17. Type of employment of hired labour by sex, 2003

Type of employment	Total		Male	%	Female	%
	Hired	%				
Union total	128,098,712	100.0	39,349,266	30.7	88,749,446	69.3
HH-based total	126,763,461	100.0	38,793,392	30.6	87,970,069	69.4
Non-HH-based total	1,335,251	100.0	555,874	41.6	779,377	58.4

As a developing country, there is undoubtedly surplus labour in the agriculture sector. Major cities in Myanmar have now become overcrowded because people are migrating in from the countryside in search of work. This is a serious problem.

Labour is being substituted by machines to some extent. Methods of production can be altered in such a way as to reduce the required number of a particular class of labourers. As for planners, policy-makers and decision-makers, they need to find proper solutions to the problems of farmers and the country and hopefully the information contained in the MCA can serve them in their analyses.

The MCA 2003 and 2010 reports provide some interesting information on improved farm practices. Farm practices comprise pesticide use, application of fertilizers, seeds, contour farming, and weeding and building dikes. Both household-based holdings and non-household-based holdings utilized the same practices. The data showed that there had been some prominent changes in the improved farm practices of the holdings between 1993 and 2003, especially for non-household based

holdings whose adoption rate increased by 851.3 percent. Household based holdings had an increase of 14.2 percent, which is very slightly lower than the rate for the country as a whole, which is 14.1 percent. The use of organic fertilizer was the most adopted improved farm practice (1993, 69 percent versus 2003, 52.5 percent).

12.2 2010 census

The fishery sector plays a pivotal role in agricultural transformation and rural development in Myanmar. The country is rich in freshwater fisheries and marine water fisheries. The fishery sector is the most important sector after the agriculture and forestry sectors. As Myanmar has a long coastline, there are a lot of opportunities for the development of inshore and offshore fisheries. Therefore, the responsible personnel of Myanmar Fisheries Federation, technicians and entrepreneurs, under the leadership of the Ministry of Livestock and Fisheries, have been trying their best to develop the fishery sector towards the emergence of international export market for fish and fish products.

Similarly, about 51 percent of the total land area of Myanmar (167,186,000 acres) is covered with forests of which 63.1 million square miles are reserved forests and protected public forests and 10.3 million square miles are under the protected area system (2009/2010). The government is serious about forest conservation. Systematic management and conservation of forestry and related matters have been firmly established and should serve future generations well. Myanmar is also dealing with deforestation to a certain extent. However, Myanmar needs to manage the forest resources to strike a better balance between nature's supply and human's demand. Table 18 shows the total of all households with agricultural holdings involved in the forestry and other sectors during the past 12 months, by sex and economic activity, based on the findings of MCA 2010.

The population (both males and females) of the households to a large extent worked in their own agricultural holdings both in 2003 and 2010, and the number increased considerably during the seven-year period (total equals 16.79 million in 2010), followed by worked in other agricultural holdings (total equals 3.48 million in 2010) and worked in forestry related activities (total equals 2.3 million in 2010). Worked in non-agricultural fishing/forestry industry and engaged in fishing and aquaculture stood in fourth and fifth positions respectively.

Table 18. Economic activity of household members by sex during the past 12 months, 2003 and 2010

Economic activity of household members	Male		Female		Total	
	2003	2010	2003	2010	2003	2010
Worked in own agricultural holdings	4,539,843	8,483,475	3,992,326	8,308,235	8,532,169	16,791,711
Worked in other agricultural holdings	293,018	1,723,167	345,546	1,761,012	638,564	3,484,179
Engaged in fishing / aquaculture	18,478	297,439	6,382	22,100	24,860	319,539
Worked in forestry related activities	412,909*	1,677,553	615,772*	658,511	1,028,681*	2,336,063
Worked in non-agricultural fishing/forestry industry		998,953		1,097,177		2,096,129
Total	5,264,248	9,056,850	4,960,026	9,037,557	10,224,274	18,094,407

* Includes other industries

Regarding economic activity of household members, there was a grand total of 18.09 million at country level in 2010 made up of 9.06 million males and 9.04 million females whereas there was a total of 10.22 million in 2003 made up of 5.26 million males and 4.96 million females. The country total in 2010 was nearly twice of that of 2003. The first item, worked in own agricultural holdings, was similar in that there were 16.79 million members in 2010 and 8.53 million in 2003. The total number of household members that had worked in other agricultural holdings was very impressive: in 2003, there was 0.64 million members made up of 0.29 million males and 0.35 million females, whereas in 2010 there were 3.48 million members made up of 1.72 million males and 1.76 million females.

Table 19 gives similar information as Table 18 but this time the results are disaggregated for male and female heads. In the table, the top three items are the same for 2003 and 2010.

Table 19. Economic activity of household heads by male and female heads during the past 12 months, 2010

Economic activity of household members	Male heads	Female heads	All heads
Worked in own agricultural holdings	14,525,745	2,265,966	16,791,711
Worked in other agricultural holdings	3,012,534	471,645	3,484,179
Engaged in fishing / aquaculture	292,385	27,153	319,539
Worked in forestry related activities	2,044,045	292,019	2,336,063
Worked in non-agricultural fishing/forestry industry	1,795,334	300,795	2,096,129
Total	21,670,043	3,357,578	25,027,621

In Myanmar, regional development and self-sufficiency in the agriculture sector depends on rural households. Comparing the households that worked in fishing and aquaculture with those engaged in forestry related activities, we can see that the latter outnumbered the former. It is natural that timber extraction can be operated in rural areas.

The forestry sector plays an important role in the economy of rural households so that sustainable forest management should be appealing to rural households and there should be support for such activities as conservation, establishment of reserved forests and sanctuaries and national parks.

Table 20 presents a breakdown of the kind of activities household members engage in on their own holdings. As can be seen, the numbers increased between 2003 and 2010 for every kind of activity (for which figures are available) except for fishing on their own holding. This was true for both males and females.

Table 20. Economic activity of household members during the past 12 months, 2003 and 2010

Economic activity of household members	2003			2010		
	Male	Female	Total	Male	Female	Total
Land preparation	3,986,818	1,634,116	5,620,934	6,692,434	1,815,420	8,507,854
Planting / transplanting	3,682,038	3,002,255	6,684,293	6,507,978	6,153,332	12,661,310
Care of crops	4,080,693	3,061,645	7,142,338	7,212,667	6,113,142	13,325,809
Harvesting, picking, threshing	3,936,040	3,303,728	7,239,768	6,844,955	6,534,969	13,379,924
Marketing of produce				3,872,968	4,042,894	7,915,862
Care of livestock / poultry	2,614,655	2,404,609	5,019,264	4,109,374	3,395,666	7,505,040
Fishing on own holding	489,251	428,825	918,076	147,940	12,101	160,041
Other involvement in the agricultural holding				411,001	549,241	960,242
Number of report				452	688	1,140
Processing/Packing	3,211,235	2,431,334	5,642,569			
Threshing	3,369,156	2,448,219	5,817,375			
Selling produce	2,852,681	2,191,014	5,043,695			
Prepare/Serve meals to HH workers	731,326	2,254,103	2,985,429			
Other farm activity	416,336	350,581	766,917			
Total	29,370,229	23,510,429	52,880,658	8,483,475	8,308,236	16,791,711

Total household members taking part in land preparation in 2010 were greater than those of 2003, with 8.5 million members and 5.6 million members respectively; and for planting and transplanting in 2010, the number taking part was 12.66 million, twice that of 2003, which was 6.68 million. Similarly, the number of household members participating in care of crops, care of livestock and poultry in 2010 was greater than that in 2003, namely 7.14 million in 2003 and 13.83 million in 2010 and 5.02 million in 2003 and 7.92 million in 2010. However, the number of household members engaged in fishing on their own holding in 2010 was less than that of 2003 (160,000 versus 918,000). This perhaps helps to give us a better understanding of the structure of the agricultural production sector.

At country level there was a total of 16.79 million household members involved in economic activities on the agricultural holdings. Care of crops stood was the number one activity in terms of the number of people involved (13.83 million), followed by harvesting and picking and threshing (13.38 million) and planting and transplanting (12.66 million). The number of male household members outstripped that of female household member in all the activities except marketing of produce (3.87 million males and 4.04 females). Fishing on own holding seems to be men's business. In Myanmar, women usually do the paddy transplanting.

The Ministry of Agriculture and Irrigation conducted a survey of the cost of cultivation per acre. Cultivation mostly involves land preparation, care of crop, plantation, reaping (harvesting), threshing and application of inputs. The ratio of expenditure and profit is as set out in Table 21.

Table 21. Total cost and profit per acre (rainy season paddy), 2005/2006

No.	Particulars	Unit	Including family labour cost	Excluding family labour cost
1	Yield per acre	Basket	55	55
2	Price per 100 basket	Kyat	200,000	200,000
3	Income per acre	Kyat	110,000	110,000
4	Cost per acre	Kyat	88,350	72,250
5	Net profit	Kyat	21,650	37,750

Source: Survey of cost of cultivation

The ratio of cost of production and income per acre is as follows:

- (a) 1: 1.25 (including family labour cost)
- (b) 1: 1.52 (excluding family labour cost)
- (c) The other crops prepared in the same way in Kayin state are given in Table 22:

Table 22. Production and profit per acre in Kayin state (2005/2006)

No.	Particulars	Unit	With family labour	Without family labour
Paddy (rain) (casting seeds)				
1	Yield per acre	Basket	50	50
2	Price per 100 basket	Kyat	200,000	200,000
3	Income per acre	Kyat	100,000	100,000
4	Cost per acre	Kyat	68,500	54,500
5	Net profit	Kyat	31,500	45,500
6	Ratio (cost: income)	Kyat	1:1.46	1:1.83
Paddy (rain) (direct planting)				
1	Yield per acre	Basket	50	50
2	Price per 100 basket	Kyat	200,000	200,000
3	Income per acre	Kyat	100,000	100,000
4	Cost per acre	Kyat	71,000	56,000
5	Net profit	Kyat	29,000	44,000
6	Ratio (cost: income)	Kyat	1:1.41	1:1.78

Source: MoAI survey of cost of cultivation

Table 22 gives a picture of households engaged in forest-related activities. Gathering firewood from forests for household energy both rural and urban comes first (1.58 million households and 1.37 million male headed households), followed by gathering wild fruits/food and then other forestry-related activities. In Myanmar, forest resources at grassroots levels, especially at the village level is of great economic importance. The current fuel wood plantation programme of 10,000 ha/year is still inadequate to meet present and future demand. However, the supply obtained from fuel wood plantations is enough to prevent deforestation to some extent.

In Myanmar, rural people's dependence on forest products is extremely important particularly for post, poles, firewood, fodder and food as can be seen from Table 23. These products enhance their incomes but they are also essential in meeting their basic needs.

Table 23. Household engaged in any forest-related activities during the past year, 2010

Sr. No	Major items	All households	Male-headed households
1	Gathering firewood cutting	1,580,644	1,373,066
2	Cutting of sandalwood / sawmill timber	22,006	19,834
3	Gathering candlenuts, coconuts	68,681	60,211
4	Gathering wild fruits / food	140,145	120,719
5	Collecting medicinal plants	8,668	7,755
6	Hunting wildlife or animals	32,006	30,241
7	Other forestry-related activities	86,527	76,135
	Union total	1,600,778	1,390,481
	For the same items		
	Rural total	1,568,148	1,362,439
	Urban total	32,630	28,042

Deforestation is a serious issue to the government. A main cause of deforestation is over-exploitation of timber and firewood. The 2010 census reveals that most communities dwelling in rural areas are engaged in gathering firewood cutting. Exploitation for fuelwood is generally beyond the carrying capacity of forests leading to serious degradation and even deforestation. Severe fuelwood deficits affect all states and divisions in the country. Extraction of charcoal from tidal forests in the delta area is problematic in Bogale, Laputta and Mawlamyinegyun. To substitute wood-based fuel with alternative energy, the government has formed a committee for Innovation and Distribution of Firewood Substitute Fuel for Arid Regions.

Table 24 and Table 25 present data on fishing by households with agricultural holdings. The fishery sector is of crucial importance to households in Myanmar. There has been remarkable development in the fishery sector because of the combined efforts of the government and various agencies. The nation believes strongly that development of the fishery sector and the conservation of fresh and marine water resources is in the best interests of the county. Streams, rivers and oceans are natural storehouses of food.

Table 24. Industrial classification of economically active population (%)

Sr. No	Industry	2010				Total
		Urban	Rural	Male	Female	
1	Fishing	0.9	2.5	3.2	0.7	2.2
2	Agriculture, hunting and forestry*	7.1	63.8	52.3	47.4	50.2

Note: (*) Agriculture, hunting forestry is included for comparison

In terms of industrial structure, agriculture, hunting and forestry is by far the biggest employer accounting for half of total employment (Table 24). But, it is an undeniable fact that many households in rural areas are engaged in the fishing industry to some extent.

Table 25 gives details about the number of households with agricultural holdings that engaged in fishing activities in 2010. All households, either male-headed or female-headed are engaged in fishing activities mainly for home consumption. As expected, male-households are more involved in fishing than female-headed households. As can be seen it is predominantly a rural activity.

Table 25. Households, persons engaged in fishing activities and purpose, 2010

Agricultural holdings	Number of households	Agricultural holdings	Number of persons
All households		All persons mainly responsible in fishing	
Mainly for home consumption	224,065	Mainly for home consumption	224,065
Mainly for sale	50,554	Mainly for sale	50,554
Total	274,617	Total	274,617
Urban	4,362	Urban	4,362
Rural	270,255	Rural	270,255
Male-headed households		Male persons mainly responsible in fishing	
Mainly for home consumption	203,637	Mainly for home consumption	220,107
Mainly for sale	46,601	Mainly for sale	50,013
Total	250,238	Total	270,119
Urban	3,812	Urban	4,312
Rural	246,426	Rural	265,807
Female-headed households		Female persons mainly responsible in fishing	
Mainly for home consumption	20,427	Mainly for home consumption	3,958
Mainly for sale	3,953	Main for sale	542
Total	24,381	Total	4,498
Urban	550	Urban	50
Rural	23,831	Rural	4,448

The fishery sector plays a key role in food security in Myanmar and will probably become even more important in the future.

In the fishery sector, both households and persons engaged in fishing by type of fishing location or by main purpose significantly declined in 2010, compared to 2003. There were 274,000 households or persons engaged in fishing activities for both of home consumption and sale in 2010 whereas there were 345,000 households or persons in 2003 (Table 26 and Table 27). Fishing activity plays a key role in ensuring the agricultural sector produces surplus food and contributes to all round development of other sectors in Myanmar.

Table 26. Agricultural households engaged in fishing activities, 2003

A. Number of fishing households by type and fishing location (on farm, off-farm)	
(1) Agricultural household	137,866
(2) Non- agricultural household	208,017
Total	345,883
B. Number of persons engaged in fishing by main purpose based on location code (pond, stream, river, etc)	
(1) Mainly for home consumption	141,221
(2) Mainly for sale	204,662

Table 27. Number of households with agricultural holdings that engaged in fishing activity, 2010

A. All households	
(1) Mainly for home consumption	224,065
(2) Mainly for sale	50,554
Grand total	274,619
B. All households (urban)	
(1) Mainly for home consumption	3,434
(2) Mainly for sale	928
Urban total	4,362
C. All households (rural)	
(1) Mainly for home consumption	220,631
(2) Mainly for sale	49,626
Rural total	270,257

13. Conclusions

The Republic of the Union of Myanmar participated in the World Census of Agriculture in 1953/54. Censuses of Agriculture were carried out in 1993 and 2003. The censuses consisted of number and area of holding by size of total area of holdings, holders by sex and age, employment, land use, irrigation facilities, annual and permanent crops, livestock, fishery and relevant facts on agriculture. The MCA 2003 estimated the total of all holding of the country at 3,399,598 which consisted of 98.36 percent of land holdings, 1.32 percent of livestock holdings and 0.32 percent of aquaculture holdings with the reported area of 22.23 million acres.

In 2010, according to main land use of parcel with all crop holdings, there were a total of 7.56 million parcels comprising 31.62 million acres. The number and area of parcels were also classified into land tenure and parcels, size of area of crop holdings.

There were 7,561,585 parcels under crop holdings, of which 6,840,850 were male-headed crop holdings and 720,735 were female-headed crop holdings. Similarly, there were 3,161,507.11 acres of all parcels of crop holdings, with 28.96 million acres classified as male-headed crop holdings and 2.65 million acres classified as female-headed crop holdings.

In 2010, there were 416,247 household heads engaged in fishing and forestry industries and 156,687 engaged in fishing and aquaculture whereas 345,939 households engaged in fishing in 2003. Today most farmlands have been shrinking as a result of urbanization and development projects. These factors are threatening food security in the country. According to the censuses, the number of parcels and agricultural holdings are increasing. In fact, parcels and holdings have become smaller in spite of increasing in number. As an agricultural country, agricultural censuses are indispensable for seeing the true picture of the agricultural sector. In Myanmar, 75 percent of the total population lives in rural areas. The findings of the censuses point to a lot of hidden labour in the agriculture sector.

In Myanmar, the number of holdings, the number of parcels and the extent of their areas play a key role in agriculture. There were 3.34 million holdings, and 7.06 million parcels in 2006 and 4.99 million holdings and 7.56 million parcels in 2010.