Mitigation of food insecurity and poverty: The role of integrated agriculture –aquaculture (IAA) systems in Malawi

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Abstract

Over the years, the paradigm to develop aquaculture as a stand-alone enterprise proved a failure in Malawi due to socio-economic status of the majority of Malawian farmers. Overall, 75% of families cannot feed themselves, producing, on average, only 64% of their own food requirements. With the low per capita land holding of about 2 ha, the most commonly proposed solution would be intensification of land use e.g. adopting new crop varieties and applying fertilisers and pesticides. Unfortunately, with the majority of farmers having a per capita income of about US$160/year, access to these technologies is limited. In this context, a shift towards more sustainable and durable farming systems in the form of Integrated agriculture-aquaculture (IAA) spearheaded seems to significantly decrease the level of hunger and enhance the ability of smallholding farm families to survive droughts.

Responding positively to the benefits of IAA the Malawi government National Aquaculture policy embraced IAA in the year 2000. This paper discusses how IAA improves farm diversification resulting in increased whole-farm productivity, household income, improved farm resilience to drought, household food security and nutritional status of under-five children. Finally, it is recommended that with such an impact on lives of rural Malawians, IAA should be incorporated in policies that deal with food security and poverty issues.

Keywords: Food security, poverty, household income, nutritional status, under-five children

Introduction

Poverty in Malawi is widespread, deep and severe with 65.3 percent of the population living below the poverty line. Studies by UNICEF/GOM (1993) and the World Bank (1996) revealed that 80% of Malawians earn less than MK 241 ($16.00 in 1996) per year. Overall, 75% of families cannot feed themselves, producing, on average, only 64% of their own food requirements. Their meagre cash income can make up only a portion of the shortfall. This food security shortfall has immediate ramifications for household nutrition, particularly among the young. Nationwide, 43% of children under five years of age are more than 20% underweight, and 56% are stunted. Mal and under nutrition are the leading causes of hospital deaths for children under the age of six years.

Although somewhat poorer than most countries, the Malawian smallholder is generally typical of potential IAA users in Southern Africa. In Malawi, 1.3 million farms directly support over 8 million people. The vast majority of these farms are very small, averaging 1.2 ha among smallholders. A recent study found that 55% of smallholders fall short of being self-sufficient in food. Farmers with less than 0.5 ha under cultivation are only able to produce 37% of what they need to feed their families (ICLARM & GTZ 1991). Studies by UNICEF/GOM (1993) and the World Bank (1996) revealed that 80% of Malawians earn less than MK 241 ($16.00 in 1996) per year, of which 94% reside in rural areas; a 50 kg bag of diammonium phosphate fertilizer retails for over MK 500.

The most commonly proposed solution is to intensify land use by adopting new crop varieties and applying fertilizers and pesticides. Unfortunately, the resources with which to access these technologies are severely limited among smallholders. Only 33% of farmers manage to actually sell for profit any of their produce and credit is unavailable. As a result, inorganic fertilizer supplies only an esti-

mated 27% of needed nitrogen for smallholder farms. The majority of smallholder agriculture enterprises must function on the natural resource base of the farm itself.

Additionally, drought is a recurrent and common threat to these farm households, and due to the low resilience characteristic of the present farming systems, famines are expected to be more frequent in the future.

In situation like this, Integrated Agriculture/ Aquaculture (IAA) seem to provide benefits that are ecologically sustainable. This paper provides brief history of aquaculture in Malawi, and the role that IAA plays at farm, regional and national levels.

History and Background of Aquaculture Introduction

The recorded history of Aquaculture in Malawi dates back to as early as 1930's when some tea estates in the Mulanje District of Southern Malawi constructed fish ponds for the breeding rainbow and brown trout for angling by the European communities. The establishment of government policy on fish farming and fishing and the Fisheries Department in Malawi (then Nyasaland) in the 1940's was a direct result of the Nutrition and Fisheries Surveys that were conducted between 1938 and 1939. Therefore, as early as 1940, fish farming in Malawi was being promoted as a means of improving the nutritional status of the rural poor. Efforts to improve aquaculture were marginal until 1957, when the National Aquaculture Center (NAC) was constructed.

Donor Assistance to the Aquaculture Sector

Donor assistance for the development of aquaculture began in the 1970s, with the implementation of the UNDP funded Kasinthula Pilot Fish Farm (KPFF) at Chikwawa in the lower Shire Valley, OXFAM & UNICEF projects in Zomba (1974 - 1979), and by UNICEF (1981-1990) in the Mwanza districts of southern Malawi. The success of the UNICEF project in Mwanza led to a shift of focus in aquaculture development strategy from the pilot large-scale fishfarming project to the smallscale fish farmer. This strategy was to be implemented through the establishment of satellite stations centrally located throughout Malawi. These stations were eventually developed through support from the United Kingdom's Overseas Development Aid (ODA) in Mulanje (catering for Mulanje, Phalombe, and Thyolo Districts), the European Union (EU) which funded the construction of six satellite stations in the Central and Northern regions from 1989 - 1994, and the Malawi German Fisheries and Aquaculture Development (MAGFAD) Project in Mwanza, Zomba and Namwera from 1987 - 1995.

Donor support for aquaculture research and technology development commenced in 1973 with the development of the UNDP-funded at Chikwawa in the lower Shire Valley. The Kasinthula Pilot Fish Farm (KPFF) was the first donor-funded aquaculture research and technology development project in Malawi. The KPFF was developed to test the viability of large-scale aquaculture, and this had little success in catering for this sector mainly due to low government funding and lack of proper policies for the promotion of large-scale aquaculture. Intensive efforts to develop aquaculture technologies suitable for small-scale fish farming started in 1987 when a broad range of biological, socio-economic, interdisciplinary research was implemented by ICLARM in collaboration with the Malawi Government and the University of Malawi. This research was funded by GTZ. Results of this research were used by the MAGFAD aquaculture extension project.

During the period 1987-1991, ICLARM had developed, on station, a suite/basket of technologies for fish production within an integrated aquaculture-agriculture system context. Extension personnel through the MAGFAD project disseminated the developed technologies to farmers. Despite achieving high yields on station, productivity of these technologies on farm remained low. By 1991, ICLARM had recognized that the classical top-down approach to technology development did not result into increased productivity and fish production. In 1991, ICLARM changed its focus for technology development from station based to on-farm participatory research. The experiences learned during this period led to the

elaboration of the farmer scientist research partnership approach to aquaculture technology development and transfer (Brummett & Williams, 2000).

Direct donor support to aquaculture development declined between 1995-2000 due to a number of factors that included changes in donor priorities, perception by donors that the sector had failed to take off despite the huge investments that were made and that the conditions for long-term sustainability of the sector had been laid out. However, despite the withdrawal of development funds to the sector, aquaculture continued to develop especially in Southern Malawi where partnerships between research and extension resulted in incremental and sustained increases in fish production and whole farm productivity. The potential for aquaculture to contribute to household food security through crop diversification and improvements in rural diets and incomes did not go unnoticed by the NGO community so that by 2001, over five NGO's in Malawi had incorporated fish farming into their food security programs.

The evolution of aquaculture from its beginnings in the 1940's to the present has been nurtured by a lot of government and non-governmental organizations. However, the take off in aquaculture development that is now being observed in Malawi could not have been possible without the intensive research, institutional and human capacity development efforts by the Malawi Government, ICLARM and Malawi's bilateral partners that occurred between 1985 and 1995.

Impact of Integrated Agriculture/Aquaculture in Malawi

Integrated aquaculture/agriculture (IAA) as the strategy for developing aquaculture in Malawi was adopted after realization that past failures in promoting the wide-scale adoption of aquaculture in Malawi and sub-Saharan Africa were due to the promotion of aquaculture as a stand-alone enterprise, which required vast investments in additional labor and finances to implement. Integrated aquaculture/agriculture is based on the concept of recycling of inputs between different components of the farm. Experience has shown that IAA has had impact both at farm and national level. At farm level IAA improves farm diversification resulting in increased whole-farm productivity, household income, farm resilience to drought, household food security, nutritional status of under-five children while at national level IAA has sustained increases in total fish production and number of farmers in Malawi.

Farm Level Impacts

Farm diversification resulting in increased whole-farm productivity

The concept of IAA encourages diversification, utilization of different resources on the farm and water management. By retaining water on the land, ponds have enabled farms to continue food production and balance their losses in seasonal croplands. Using technologies developed on-station and on-farm, it has been demonstrated that IAA is an ecologically and economically viable system for producing fish, managing water and diversifying production on small-scale farms. For example fish production in IAA systems in Malawi is about 1500kg/ha/yr of fish compared to about 900kg/ha/yr for non-integrated farms (Brummett & Noble 1995).

In terms of diversification, it has also been shown that fish farming encourages farmers to diversify into the production of small ruminants and poultry. A recent socio-economic study involving 480 households in four high aquaculture potential areas of the country has shown that fish farming households have more livestock than non-fish farming households. The results of the survey showed that fish farming households had more goats (2.8) and chickens (6.44) than non-fish farming households who on average had 1.7 goats and 4.21 chickens. The observed differences can be attributed to the need for manure for fish farming that may encourage fish farming households to have more livestock.

Increased farm resilience to drought

Productivity of smallholding farms in Malawi is prone to drought, the severity and frequency of which is expected to increase with climatic change. Farmers in Malawi have no tradition in water management, therefore apart from drought,

prolonged water stress during otherwise normal rainfall seasons could negatively affect farm production. The integration of aquaculture into existing farming systems have, in addition to allowing farmers to grow fish, provided entry level technology for water management on small farms. This water management has allowed farmers to increase the length of the crop-growing season and to mitigate against drought. For example, in 1993/94 when only about 60% of the normal rain fell, the average net cash income for IAA farms in Zomba-West, which in 1993 had 206 farmers, was 18 % higher than that of non-integrated farms (Brummett & Chikafumbwa 1995). The difference came about due to the continued production with pond water and mud. The integration of ponds in some farms has turned the previously uncultivated land into cultivation, and the pond water has extended the production period into the dry season (Table 1).

Such IAA farms have proved to have more resilience towards drought conditions than non-integrated farms. This in itself is indicative of an element of sustainability of fish farming particularly to those that have advanced in their operations.

Household income

The introduction of aquaculture into existing farming systems has increased farm household income due to the high net returns of fish farming and the synergistic effects of aquaculture on livestock and *dimba* crops which results in fish farming households owning and sell relatively more livestock and dimba crops compared to non-fish farming households (Table 2).

Fish farming households also had generally more annual income (MK6401) compared to MK5674 for non-fish farming households. Fish farming has been estimated to contribute from 4 to 39 % to annual household income (Petry, 1996; Scholtz & Chimatiro, 1995). Scholtz & Chimatiro (1995) using data from 48 small-scale fish farmers in the southern region indicated that on average the farmers realized about 27% (11% and 16 % from table size fish and fingerling sales respectively) of their income from fish sales (Table 3).

Returns to labor from fish farming are higher than the minimum wage. In the evaluation of fish farming activities in Mwanza and Zomba West areas, Chimatiro & Janke (1992) found that returns to labor were US$1.21 and US$2.24 per man- day in Mwanza and Zomba West respectively (Table 4). In both places the returns to labor from fish farming were higher than the national minimum wage rate of US$0.80 per man-day.

Although land under fish farming was considerably smaller compared to land under other crop cultivation, the authors found that fish

Table 1. Effect of ponds on the farming environment of 21 smallholder farms in the Chingale-Chinseu Area Zomba District, Malawi (ICLARM, 1992).

Effect of pond on farming system	Number	Percent
Marginal land brought into production	7	33
Vegetable garden adjacent to pond expands due pond improving soil water relations in adjacent soils	4	19
New vegetable garden starts in association with pond	2	10
Vegetable garden soil fertility improved with pond mud	5	24
Household uses pond as domestic water supply	7	33
Recycling of crop/animal wastes starts or increases due to use of pond inputs	21	100
Rice fish integration starts	5	24
Household cash income increases due to sales of fish and/or increased sales from vegetables, rice etc from gardens adjacent to ponds	15	71
Food supply for farming family improves	18	86

Table 2. Major sources of cash income by household type (ICLARM, 2001).

Sources of income	Rank 1				2				3			
	Fish farming (n, %)		Non-fish farming (n, %)		Fish farming (n, %)		Non fish farming (n, %)		Fish farming (n, %)		Non fish farming (n, %)	
None			6	4.8	34	25.0	51	41.1	83	61.0	96	77.4
Sale of dry land crops	71	51.8	63	50.8	23	16.9	17	13.7	11	8.1	3	2.4
Sale of *dimba* crops	28	20.4	8	6.5	37	27.2	28	22.6	10	7.4	11	8.9
Sale of livestock	10	7.3	4	3.2	16	11.8	10	8.1	9	6.6	7	5.6
Sale of fish from ponds	9	6.6			17	12.5			17	12.5		
Small-scale business	13	9.5	25	20.2	8	5.9	13	10.5	6	4.4	4	3.2
Remittances from relatives	2	1.5	4	3.2			1	0.8			2	1.6
Wages/salary	4	2.9	14	11.3	1	0.7	4	3.2			1	0.8
Total	137	100	124	100	136	100	124	100	136	100	124	100

Table 3. Production data from 48 small scale fish farmers in the southern region of Malawi.

Enterprise	Enterprise category	Yield	Annual Sales (MK)	% of total income
Fish	Table size (kg)	45.5	213	11
	Fingerlings (No)	1523	306	16
	Table size (home consumption) (kg)	4		
Vegetables	Green leaves and fruits		908	48
Livestock	Goats, chickens, ducks		472	23

Source: The Promotion of small scale aquaculture in the Southern Region of Malawi, a reflection of extension approaches and technology packages used by the MAGFAD (Scholtz and Chimatiro, 1995).

Table 4. Gross margin analysis for fish farming in Mwanza and Zomba West in 1990 (Jhanke and Chimatiro, 1992).

	Mwanza US$	Zomba-West
Average pond size per farmer (m^2)	140	560
Average Net Production (Kg/ha/yr)	1745	1565
Average Net Production per farmer/yr (kg)	24.4	37.6
Gross income (MK)	23.46	84.23
Gross margin (MK)	20.04	71.58
Depreciation (MK)	4.29	17.16
Interest (MK)	0.68	2.50
Net gross margin (MK)	15.07	51.92
Gross margin (MK) /person-day	1.82	11.01
Net gross margin (MK) /person-day	1.37	7.99
Gross margin (MK)/hectare	1431.43	1278.21
Net gross margin (MK)/hectare	1076.43	927.14
Gross margin/variable cost	5.88	5.73
Net gross margin/variable cost	4.42	4.16
Returns to labor	1.21	2.47
Net returns to labor	0.91	1.80

farming contributed about 12% in Mwanza and 39% in Zomba West to total household cash income.

Household food security

The introduction of IAA, has increased food security at the household level among fish farming households. For example, surveys conducted by ICLARM have shown that relatively more fish farming households in southern and central Malawi have maize and cassava across the season compared to non-fish farming households (Table 5). The differences in the availability of maize and cassava between fish and non-fish farming households can be attributed to the high productivity of IAA farms. It is also possible that farmers that grasp the concepts and fundamentals of IAA are more likely to understand and utilize new technologies for the production of other farm crops much better than non-IAA farms.

Nutritional status of under-five children

Since its introduction to Malawi in the early 40's, fish farming has been promoted as a means of improving the nutritional status of the rural poor. However, until recently, there have been very limited assessments of the contribution of aquaculture on household nutritional status in Malawi. Two studies covering Dedza and Ntcheu districts and four high aquaculture potential areas were conducted in 1990 and 2000/2001 respectively. The aim of the 1990 study was to examine the influence of aquaculture on household food security, food consumption, and nutritional status of young children aged up to 6 years. A total of 108 families were interviewed comprising 55 families with fishponds and 53 families without fishponds. In December 2000 and January 2001 a food security and nutritional study was conducted among 262 households in Mangochi, Mwanza, Dedza and Mulanje (at least 30 fish and 30 non-fish farming households in each area). The major objective of the survey was to document the impact of fish farming on household food security and nutritional security

The results of the 1990 survey indicated that there were no significant differences in levels of underweight (Low weight-for-age) (Table 6a) and wasting (Low weight-for-height) (Table 6b) in the children from households with and without fish farming. Stunting rates on the other hand were less prevalent in children from families with fishponds (25% with height -for-age <90%) than in children from families without fish ponds (29% with height-for-age <90%) (Table 6c). The results

Table 5. Seasonal availability of maize and cassava among fish and non-fish farming households. Percent values represent the proportion of respondents who indicated to having adequate maize and cassava supplies during each calendar month (ICLARM, 2001).

Calendar month	Household Type							
	Fish farmer				Non fish farmer			
	Maize		Cassava		Maize		Cassava	
	n	%	n	%	n	%	n	%
January	56	40.6	52	37.7	41	32.8	30	24.0
February	42	30.4	50	36.3	27	21.6	25	20.0
March	43	31.2	43	31.2	31	24.8	26	20.8
April	96	69.6	40	29.0	89	71.2	20	16.0
May	110	79.7	41	29.7	100	80.0	21	16.8
June	133	96.4	41	29.7	122	97.6	21	16.8
July	137	99.3	46	33.3	120	96.0	24	19.2
August	136	98.6	51	37.0	115	92.0	28	22.4
September	129	93.5	53	38.4	104	83.2	36	28.8
October	119	86.2	58	42.0	95	76.0	39	31.2
November	110	79.7	59	42.8	85	68.0	38	30.4
December	89	64.5	58	42.0	67	53.6	36	28.8

Table 6a. Children's Nutritional Status using Weight for Age Indicator (Ayoade, 1990).

% Standard Weight-for-Age	Families with ponds n=63		Families without ponds n=70	
	Freq.	%	Freq.	%
Less than 60%	1	2	1	1
Less than 80%	21	33	23	33
Over 100%	8	13	6	9

Table 6b. Children's Nutritional Status using Weight for Height Indicator (Ayoade, 1990).

% Standard Weight-for-Age	Families with ponds (n=63)		Families without Ponds (n=70)	
Weight-for-Age	Freq.	%	Freq.	%
Less than 60%	1	2	0	0
Less than 80%	1	2	2	3
More than 100%	21	33	35	50

Source: The Role of Aquaculture In Household Food Security, Nutrition And Health Status (Ayoade, 1990).

Table 6c. Children's Nutritional Status using Height for Age Indicator (Ayoade, 1990).

	Families with Ponds (n=63)		Families without Ponds (n=70)	
Height-for-Age	Freq.		Freq.	%
Less than 60%	1% Standard	2	0	0
Less than 90%	16	25	20	29
More than 100%	8	13	4	6

Source: The Role of Aquaculture In Household Food Security, Nutrition And Health Status (Ayoade, 1990).

of the 1990 survey are comparable to those of the 2000/2001 surveys in Mangochi, Mwanza, Dedza and Mulanje. In all these areas, fish farming households had significantly high consumption of fresh fish the past seven days and one month (Table 7a & b) to the survey compared to non-fish farming households.

About 38% of fish farming households had eaten fresh fish seven days preceding the survey date compared to 18% of non-fish farming households. About 51% households with fish farming had eaten fresh fish within the preceding month to the survey compared to 30% of non-fish farming households. Severe cases of malnutrition were found in non-fish farming households where out of the severely malnourished children, 57% were severely wasted, 53% severely underweight and 59% severely stunted compared to 43% wasted, 47% underweight and 41% stunted from fish farming households respectively (Table 8).

Regional and National Level Impacts

Sustained increases in total fish production and number of farmers

Apart from farm level impacts, the use of IAA as a strategy for promoting the development of aquaculture in Malawi has resulted in sustained increases in fish production from small farms and the number of farmers incorporating fish farming into their existing farm ecosystems. In the 1980s total annual fish production from fishponds was around 90 tons per year, the bulk of which was produced in the Southern Region from 319 smallholder ponds and 26 ha of estate (tea and sugar) ponds. The total fish production from fishponds has now increased to 750t per year (Fig. 1). However, official statistics underestimate actual fish production by as much as 30%, hence, actual fish production may be higher than that stated above.

Apart from increases in the total fish production, the number of fish farmers has also increased significantly in all the major fish farming areas of Malawi (Fig. 2). The increase between

Table 7a. Frequency (by survey area and household type) of fresh fish consumption the past seven days before the survey (ICLARM, 2001).

Survey area	Household type							
	Fish Farming (n=138)				Non fish farming (n=124)			
	Consumed		Not consumed		Consumed		Not consumed	
	n	%	n	%	n	%	n	%
Mwanza	13	44.8	16	55.2	0	0	29	100
Dedza	5	16.7	25	83.3	3	11.5	23	88.5
Mulanje	14	34.1	27	65.9	4	2.1	29	87.9
Namwera	20	52.6	18	47.4	15	41.7	21	58.3
Total	52	37.7	86	62.3	22	17.7	102	82.3

Table 7b. Frequency of Fresh fish consumption a month preceding the survey by household type (ICLARM, 2001).

Frequency of consumption	Household type			
	Fish farmer		Non-fish farmer	
	n	%	n	%
None	67	48.5	85	70.2
Once	21	15.0	16	13.2
Twice	16	11.6	8	6.6
Three times	14	10.1	4	3.3
More than three times	20	14.8	8	6.6
Total	138	100.0	121	100.0

Table 8. Occurrence of malnutrition among under- five children by household type.

Nutritional indicator	Severity	Household type					
		fish farming (n, %)		Non-fish farming (n, %)		Total (n, %)	
Wasting (WHZ)	Below -3.00SD	3	42.9	4	57.1	7	100
	Below -2.00SD	6	75.0	2	25.0	8	100
	Total	9	60.0	6	40.0	15	100
Underweight (WAZ)	Below -3.00SD	15	46.9	17	53.1	32	100
	Below -2.00SD	15	35.7	27	64.3	42	100
	Total	30	40.5	44	59.5	74	100
Stunting (HAZ)	Below -3.00SD	36	40.9	52	59.1	88	100
	Below -2.00SD	20	57.1	15	42.9	35	100
	Total	56	45.5	67	54.5	123	100

Source: ICLARM (2001): Food security and nutritional status baseline socio-economic survey - a case study of Namwera, Mwanza, Mulanje and Dedza.

1995 and 2000 has occurred with no direct donor support to the extension sector. Rapid increases in the number of farmers have been observed in the high potential areas of Mchinji and Lilongwe, where the active participation of NGO's such as CARD and World Vision International has resulted in rapid adoption rates of IAA technology.

Policy implications

The new Malawi Fisheries and Aquaculture Policy of 2000 has incorporatred IAA as a way to enhance the livelihood of rural communities.

However, the policy on IAA in other related sectors policies seem to be silent. It is hence sug-

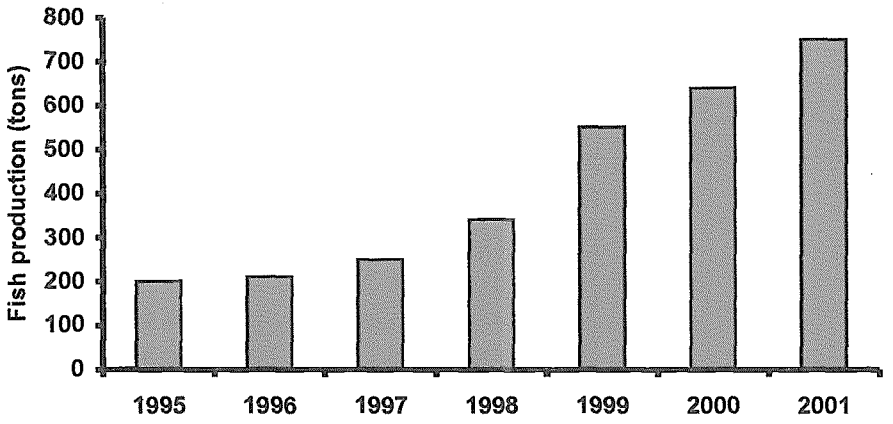

Fig. 1. Aquaculture production in Malawi.

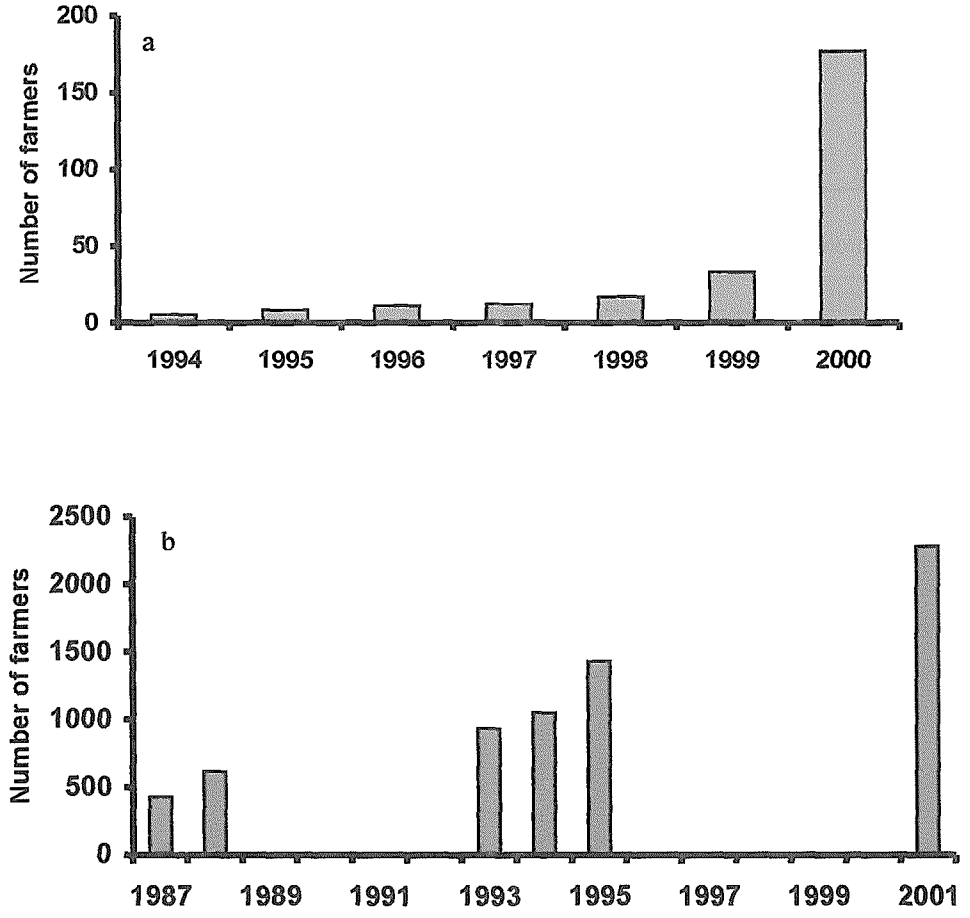

Fig. 2. Number of farmers in (a) the Lilongwe-Mchinji Extension area and (b) southern Malawi.

gested that all development efforts should incorporate IAA so that lives of rural communities are transformed and farms made sustainable.

Finally, IAA has a potential to transform the farming systems and reduce food insecurity and poverty by improving farm diversification resulting in increased whole-farm productivity, household income, and farm resilience to drought. In addition, IAA improves nutritional status of under-five children. Hence, IAA needs to be incorporated in all policies that deal with food security and poverty issues.

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