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Fishing Farmers: Fishing, Livelihood Diversification and Poverty in Rural Laos

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Abstract The relationship between fishing, livelihood diversification and poverty was investigated in the lower Mekong basin, in Laos, where fishing forms an important, but usually secondary part of rural livelihoods. Results from a household survey show that participation in fishing is common and positively associated with higher occupational diversity and more agricultural activities. This is likely due to the low opportunity costs associated with many forms of fishing and factors such as tradition, enjoyment of fishing, underutilised labour and low capital requirements. Alternative livelihoods within the rural setting are therefore unlikely to cause fishers to leave the fishery, but instead strengthen the livelihood portfolio as a supplementary activity. Fishing is not an activity only for the very poorest households, but is undertaken by all wealth groups. However, fishing forms a greater proportion of income, employment and food security for the poor and is important in households with poor quality farm land.

Keywords Inland fisheries · Alternative livelihood · Diversification · Poverty · Laos · Mekong

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Introduction

An estimated 93–97 million people were directly involved in fishing, processing and marketing in small-scale fisheries in the developing world in 2008, 51 million of whom were associated with inland fisheries (BNP 2008). Small-scale fishing in developing countries has often been termed a 'livelihood of last resort', originally for coastal fishing (Panayotou 1982), and more recently for inland fisheries (Nguyen Khoa and Smith 2004; Smith *et al*. 2005; Ellender *et al*. 2009). This concept implies that fishing is chosen due to a lack of alternative options and has led to suggestions that problems of overfishing can be addressed by providing alternative livelihood options that would entice fishers out of the fishery (McManus 1997; Kühlmann 2002; Allan *et al*. 2005). However, there is little empirical evidence to show whether additional livelihood options actually result in a reduction in fishing.

The alternative livelihood proposition is rooted in a fairly narrow view of fishing livelihoods as consisting of either fishing or an alternative. However, it has been observed that for many coastal and rural people fishing is just one economic element within a multitude of activities that constitute their livelihood strategy (Allison and Ellis 2001). Inland fisheries in particular are highly complex and may play a variety of roles in the often diversified livelihood of the fisher households (Smith *et al*. 2005; Welcomme *et al*. 2010). In fact the largest share of inland fisheries catches come from rural people whose livelihoods involve fishing but for whom it is not their primary productive activity and who do not define themselves as fishers. Many are fisher–farmers who combine farming with fishing, often part time and in distinct seasonal cycles (Smith *et al*. 2005; Béné and Friend 2011) as closely integrated parts of household livelihood strategies. The Lao Agricultural Census concluded that 80 % of the population are involved in

farming, yet 71 % of these were also engaged in fishing (Nations Encyclopedia 2009).

Despite a wealth of examples of diversification associated with fishing livelihoods, it is still poorly understood how diversification strategies influence fishing activities and, ultimately, pressure on fisheries resources (Brugère *et al*. 2008). On the one hand, it has been argued that diversification can ease exit from the artisanal fishing sub-sector (Allison 2005), whereby diversification can reduce pressure on resources in times of scarcity or diminishing returns by providing alternative options while fish stocks and/or markets recover (Jul-Larsen *et al*. 2003). This has been supported by studies investigating fisher responses to theoretical scenarios, which have shown that fishers with more livelihood options were more likely to exit a declining fishery (Cinner *et al*. 2009; Daw *et al*. 2012). On the other hand, however, it has been argued that diversification helps keep people in fishing despite resource scarcity by subsidising unviable fishing activities. An example of this is female domestic labourers in Southeast Asian cities sending remittances home that allow the male household members to continue unprofitable fishing (Pauly 2006; Brugère *et al*. 2008).

The concept of fishing as a livelihood of last resort implies an association of small-scale fisheries with poverty, however this has been questioned, both empirically and theoretically (Pollnac *et al*. 2001; Béné 2003). There have been examples of situations in which fishers are indeed poorer than their non-fishing counterparts (Cinner *et al*. 2010), but the reverse has also been shown in studies where fishers have higher incomes than those of non-fishing households in the same villages (Allison 2005). Yet further studies have shown situations in which fishing is engaged in by a wide range of socio-economic groups (Garaway 2005). This evidence from the literature suggests the idea that fisheries are synonymous with poverty is too simplistic and often incorrect and fishers need to be understood in a wider socio-economic context (Béné *et al*. 2003; Daw *et al*. 2009). The linkages between livelihood diversification, poverty and fishing have important implications for fisheries development policy. Acceptance of the theory of fishing as a livelihood of last resort, for example, might suggest creation of alternative livelihoods as a key response to overfishing, while fishing restrictions may be seen as socially unacceptable. Conversely, acceptance of the theory of fishing as a profit-oriented choice would imply that fishing restrictions may be acceptable and beneficial (Smith *et al*. 2005).

This paper explores the role of fishing within rural, predominantly farming-related livelihoods in Laos. It focuses on the way in which livelihood diversification and relative socio-economic status affect fishing behaviour and the role of fishing in providing nutrition and income.

Methods

Study Area

The field study was carried out in Savannakhet Province, southern Laos (Fig. 1) in the Lower Mekong Basin. The Lower Mekong has a population of over 55 million across Cambodia, Thailand, Vietnam and Laos, of which a substantial proportion are involved in some form of fishing. Laos has a tropical climate with an average daily maximum temperature of 31 °C and an average annual precipitation of 1500 mm, about 75 % of which occurs in the monsoon season (May–October). The country is one of the poorest nations in the world with a primarily agricultural economy; the sector produces over 50 % of GDP (Bouahom *et al*. 2004). In Savannakhet Province, southern Laos, the majority of farmers are subsistence farmers, producing rice mainly for their own consumption (Chinvanno *et al*. 2008). They have farms of moderate but on average sufficient size for producing rice to support the annual consumption of the farm household, and use of mechanised and advanced farm technology is limited.

Fieldwork took place in the district of Champhone, a wetland region of the Xe Champhone river, an important tributary of the Mekong. The landscape comprises rice paddy (accounting for about 80 % of the cultivated area), lakes, swamp forests, freshwater marshes and numerous dry season standing waterbodies (Claridge 1996). The rice field production systems in Champhone are all composed of lowland rain fed paddy of which some is also irrigated. Localised seasonal flooding affects the type of farming possible so rain fed, non-irrigated paddy may be further divided into land which floods during the wet season and land which is situated on higher ground or further from the river so does not flood. Land

Fig. 1 Map of the study area, Savannakhet Province, Lao PDR

quality affects agricultural productivity and food security through its impacts on both food supplies and their incomes, influencing their decision-making (Weibe 2003).

Field Methods

Rapid Rural Appraisals (RRA), participatory wealth ranking and a quantitative household survey were carried out in order to characterise households and the fishing and agricultural activities they engaged in. Baseline information on villages, agricultural systems and fishing activities was established through the use of RRAs. Following these, a sample of ten villages were selected for in-depth study, stratified to represent a variety of distances from waterbodies and markets, farm types, wealth and key occupations with the help of the local district fisheries staff. Wealth ranking, a participatory method of monitoring relative wealth based on local measures of well-being, was used to reflect the local definition of wealth. This was carried out using a card sorting method in which all households in the village were ranked by three separate groups of village informants (Mukherjee 1993).

Stratification of sampling within villages was carried out by selecting an equal percentage of each wealth group classified by the wealth-ranking exercise; 'rich', 'middle' and 'poor', so that the sample was composed of a proportion of each wealth group consistent with the proportion of that wealth group within the total village population. Households were selected at random from each of the three groups. A sample size of 107 per socio-economic group was calculated as necessary to be 80 % certain of being able to detect a significant difference (α=0.05) in the socio-economic status of the households (Sokal and Rohlf 1969). Sampling continued until each wealth group had a minimum of ~107 households resulting in a total of 519 households surveyed.

A formal household survey was conducted using a structured questionnaire covering asset wealth, as determined by the most influential criteria defined by informants through the wealth ranking, and occupational activities carried out by the household. Further questions were asked regarding fishing activities including the quantity of fish caught and the destination of the fish, such as whether they were sold, or consumed within the household. Catch quantity was estimated by facilitated recall using a method similar to that described by Garaway (2005). Respondents were shown length sticks with 5 cm boundaries highlighted as a visual aid for recall and asked to recall the number and length class of catches. Smaller fish (<5 cm) were instead estimated by volume in terms of the number of bowls of fish obtained, using an example bowl of known weight when full with small fish. As the smaller fish are used for making the local dish '*padek*' in bowls, measuring by volume rather than length was deemed more appropriate. To calculate the biomass of large fish from estimated lengths, the most common species were separated into three categories based on the similarity of their length-weight relationship. Surveys took place from October to December 2008, during the main rice growing season.

Metrics Used to Quantify Household Wealth, Diversity of Activities and Life Cycle Stage

Household survey data on the selected wealth indicators were used to construct a wealth index through the application of Principal Components Analysis (Filmer and Pritchett 2001; Hargreaves *et al*. 2007; Howe *et al*. 2008). The wealth index showed a highly significant positive correlation with the participatory derived wealth rank classification (ANOVA F=207.4, df=516, p<2.2e-16). A rice-based vulnerability index:

$$Rice\ index = \left[\frac{(a+b)}{5}\right] + 0.5$$

where a=−0.5 times the number of years with insufficient rice, and b=0.5 times the number of years with sufficient or surplus rice production in the previous 5 years (Garaway 1999). This was used to compare vulnerability in terms of rice-sufficiency of households that were recorded to participate in fishing activities (in either season) in the household survey. Rice sufficiency was chosen as a vulnerability criterion because it is commonly used by both rural people and government agencies in Laos. A variety of other, locally appropriate criteria have been used elsewhere (Béné 2009; Mills *et al*. 2011).

Occupational diversity has been defined in a number of different ways in a variety of studies, often involving a combination of different sectoral, spatial and functional categories (Islam *et al*. 2006; Iiyama *et al*. 2008; Cinner *et al*. 2009). In this study, quantifying the diversity of household activities has been undertaken using 'occupational diversity' defined as the total number of productive household activities using sectoral classifications rather than functional and spatial groupings, due to the low ambiguity of the method (Barrett and Reardon 2000). The categories of activity were based on those described by Ellis (2000), modified to ensure the basis was purely sectoral and relevant to the local situation in Laos. These included both natural resource-based or 'agricultural' activities and non-natural resource based or 'non-agricultural' activities, which includes off-farm activities such as the collection of forest products.

Household life cycle stages were defined based on literature on household stage definitions and Laoatian village family structure (Table 1) (Garaway 1999). Lao Loum households are traditionally matrilineal, whereby the eldest daughter marries and her husband lives with her parents and family until the next eldest daughter marries. The elder couple then set up home nearby and this continues. The household unit often consisted of more than two generations living together

Table 1 Stages of the household lifecycle

Stage	Definition	Characteristics
1	All children <10	Young, small families with a household head in his 20s or 30s, occasionally supporting an elderly parent or sibling.
2	Youngest child <10	Large families. Usually consists of three generations with a household head in his/her 30s–50s, elderly parents and many young children.
3	Youngest child 10–15	Large families. Mostly two generations, older children and children-in-law within the household.
4	Youngest child>=16	All adult households consisting of mostly two generations. Some very large (>8), some fragmented family groups with single parents and children/siblings. Many children-in-law living within the household.
5	No children	Mostly older couples/singles/siblings. Very small households

(up to four), and other extended family, with children-in-law a common feature of stages 3 and 4. Households did not undergo the bachelor and childless couple stages typical in more developed countries, but instead most had their first child within the family home and generally only left home and formed a new household once they had at least one child (stage 1). As many older people would end their lives in the family group in stages 1–4, stage 5 is not necessarily a stage all households pass through, but contained older couples, older single or young single males living alone. This was a less common household stage, comprising only 16 households.

Statistical Methods

A binary logistic regression model was used to determine the effects of explanatory variables on whether a household went fishing or not in the previous week. Seven explanatory variables were used: wealth (index derived from the PCA), rainy season rice yield, household life cycle stage, highest level of education in the household (primary, first and second secondary schools and university), occupational diversity, farm production type (which represent the differences in ecological zones between villages) and number of dependents in the household. Explanatory variables were explored for collinearity by examining pairwise plots and generating Spearman's rank correlation coefficients for each pair of variables. High collinearity was taken according to the rule-of-thumb in which ±0.5 is indicative of high collinearity. This resulted in the removal of the variable rainy season rice yield. Model selection took place using the 'stepAIC' function in R (Zuur *et al*. 2009) which resulted in the further removal of the variables education and number of dependents. Fitted probabilities and standard errors of binomial proportions were calculated for the explanatory variables of the best fitting model (Crawley 2007).

Wilcoxon rank sum tests were carried out to compare the mean wealth index of households recorded as fishing or not fishing and likewise the rice-based vulnerability index of households which did and did not fish. To assess the extent to which fish catches were used for income generation and nutrition by different wealth groups, Kruskal-Wallis rank sum tests were used to compare the proportion of fish sold and consumed by households. To investigate the contribution of fishing to household employment, the total number of household activities undertaken by fishing households was compared among wealth groups in an analysis of deviance with poisson errors followed by a Tukey multiple comparisons test. The number of agricultural activities associated with households recorded as fishing or not fishing was assessed using a glm with a binomial error structure and logit-link.

Results

Fishing and Livelihood Diversity

Occupational diversity ranged from one to seven sectoral groupings, with the vast majority of households engaging in

Table 2 Categories of household occupations and frequency of participation estimated from the survey

Natural resource based activities	Households (%)	Non natural resource based activities	Households (%)
Crop cultivation	95.57	Rural trade/business	52.41
Livestock rearing	94.80	Industrial labourer	18.69
Fishing	57.80	Services/profession (e.g. teacher, health visitor)	3.85
Collection (forests, aquatic resources)	20.70	Vehicle driving	2.89
Non-farm natural resource use e.g. brick making, weaving, carpentry	14.64	Government duties	1.54
		Other skilled labour (e.g., mechanic, tailor)	0.58

Remittances not included as they are a spatial classification

multiple occupations. The agricultural activities of crop cultivation and livestock rearing were by far the most common, with around 95 % of the sampled households participating (Table 2). Fishing was also very common with 58 % of households recorded as participating in fishing. Non-natural resource based occupations were important but secondary overall, the most common being rural trade/business (52 %) and industrial labour (19 %).

Occupational diversity was significantly and positively associated with the probability of fishing (Fig. 2a). Of households with only one occupational activity, not one listed fishing as that occupation. Stage in the household life cycle also had a significant effect on the probability of fishing, with a lower probability at stages four and five of the life cycle (Fig. 2b). The wealth index indicated there was greater variation in the probability of fishing in richer households (Fig. 2c), corresponding to the remarks by people of all wealth groups during the RRA that fishing was an enjoyable pass-time and not seen only as a productive activity. The probability of households fishing in villages which were subject to regular inundation by the Xe Champhone river was significantly higher than in villages which were

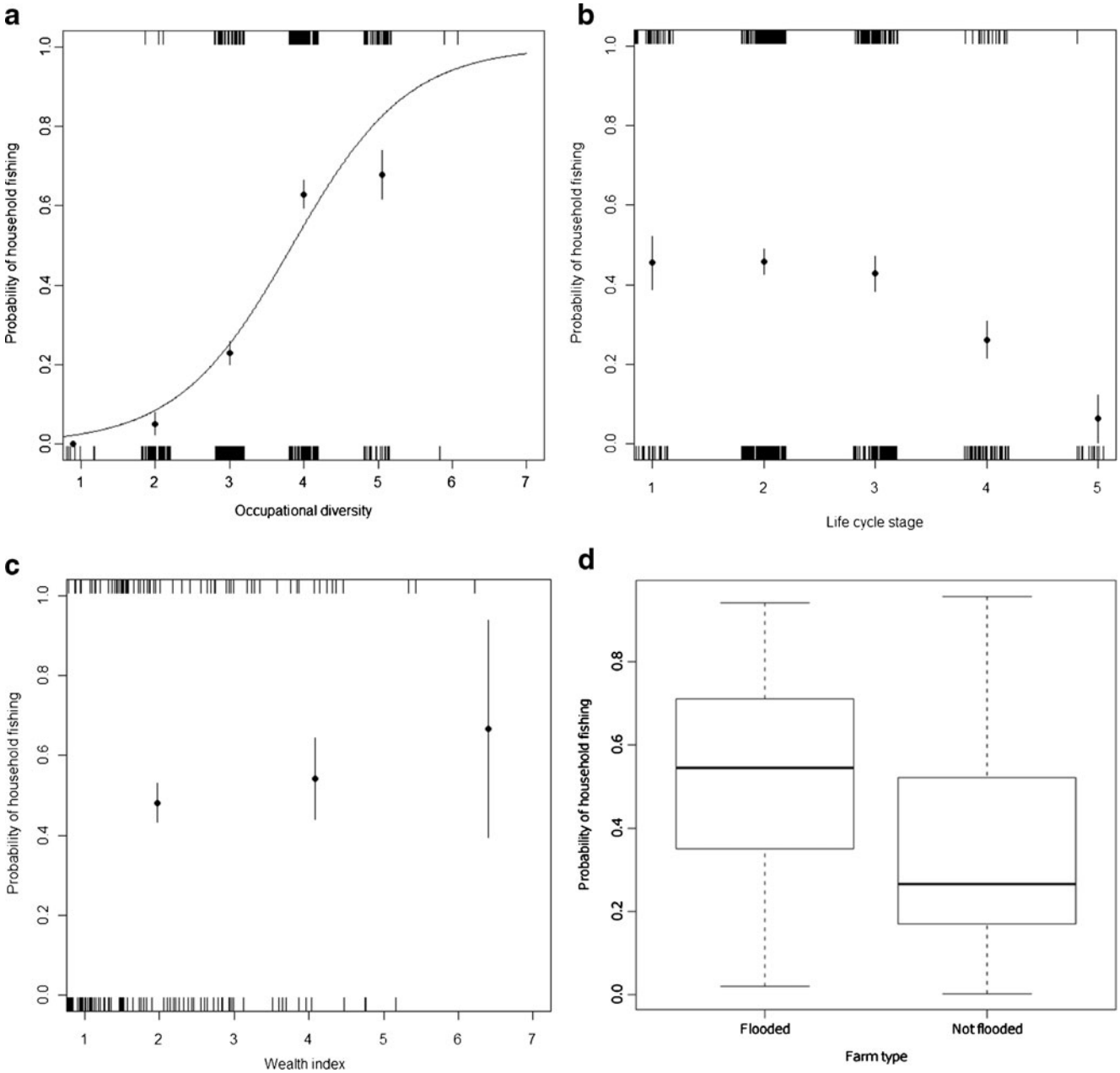

Fig. 2 Probability of fishing in the previous week with (**a**) occupational diversity, (**b**) stage in the household life cycle (**c**) wealth index (fitted probabilities±1 s.e.) and (**d**) farm production type where irrigated and non-irrigated non-flooded land were combined (n=519)

not subject to such flooding (Fig. 2d and Table 3). These villages subject to regular flooding were significantly poorer than villages which did not flood when measured using the survey-derived wealth index (ANOVA F=19, df=516, p<0.001), or the wealth-ranked groupings (χ2=63, df=4, p<0.01).

Of the households that took part in fishing activities, richer households had a significantly higher mean total number of activities (6.6 ±0.33, 95 % CI) than either poor (5.0 ±0.36, 95 % CI; z=3.8, p<0.001) or middle wealth ranked households (5.7±0.20, 95 % CI, z=2.5 p=0.03) (Table 4). This suggests fishing activities form a larger proportion of household occupations in poorer households (Fig. 3a). Households that undertook fishing activities also undertook a significantly higher number of farming activities (z=3.4, df=517, p<0.001), which comprised 83 % (±1.34, 95 % CI) of their livelihood portfolio (Fig. 3b). Households that did not fish had livelihood strategies involving 76 % (±2.58, 95 % CI) farming activities, indicating that fishing was positively associated with agriculturally focused livelihood strategies.

Fishing and Poverty

There was no significant difference between fishing and non-fishing households in the rice-based vulnerability index (Wilcoxon value=33,287, p=0.72) or the wealth index (Wilcoxon value=23,980, p=1). The proportion of households fishing was highest among the poor households 62 % (±8, 95%CI), followed by the middle 57 % (±6, 95%CI) and rich 54 % (±9, 95%CI). However, the majority of households fishing were in the middle wealth group, which accounts for more than half of the sample and the population.

Relative wealth of households influenced the choice of fishing location and gear type. Of households that fished, the majority of middle (73 % ±8, 95 % CI) and poor (71 %± 12, 95 % CI) households used the open-access lakes and reservoirs, compared with only 32 % (±14, 95 % CI) of rich households (Fig. 4a). A higher proportion of rich households (48 % ±15, 95 % CI) fished in privately owned ponds and rice fields compared with middle and poor households (17 % ±7 and 9 % ±8 respectively, 95 % CI). Wealth and fishing location were not independent (χ^2=38, df=8, p< 0.01). Gill nets were by far the most popular gear type across all wealth groups. These were followed in popularity by hooks for poor wealth groups, by hooks and cast nets for middle and by cast nets for the richer group. Semi-structured interviews revealed that price differences in gears as well as the types of water body accessible accounted for these trends as hooks were cheaper than cast nets, which were relatively expensive. The percentage of traps used by the poor was extremely low, but higher for middle and richer wealth groups (Fig. 4b). Traps were also cheap but their use depended on owning enough rice paddy in which to set them.

Overall, a large proportion (62 % ±3 %, 95 % CI) of the total fish catch was consumed within the household. The proportion consumed was similar (58–59 %) among the poor and middle wealth groups but higher, 75 %, among the rich (this difference was significant only at 90 %; Kruskall Wallis χ^2=3.60, df=1, p=0.058). The mean proportion of fish sold across all wealth groups was moderate (30.4 % ±0.4, 95 % CI). The middle and poor groups sold more (33.4 % ±8.9 and 34.4 % ±12.8, 95 % CI respectively) of their fish catch than the rich households (17.6 % ±11.6, 95 % CI). This difference in the allocation of catches to cash income generation was significant (Kruskal-Wallis χ^2= 6.36, df=1, p=0.012). There was great flexibility in the methods of selling fish, including direct sale to other households within a village, salesmen who would transport fish to nearby villages, or transporting fish to the closest market. Because of the variety of methods, sale of fish is not necessarily limited to those with greatest access to the large markets. Of all employment activities undertaken by fishing households, rice farming and fishing formed, on average, the largest contribution to household cash income according to results from RRA focus groups. The extent of the contribution to income varied depending on the type of farmland in the village. In farms not subject to over-flooding in the rainy season, rice farming provided the greatest contribution to household income whereas in farms which over-flooded in the rainy season, fishing provided a greater contribution to income.

Table 3 Variables associated with households fishing in the previous week

	Coefficient	Standard error	Lower CI	Upper CI	Wald z	p
Intercept	−3.57	0.62	−2.36	−4.79	−5.79	<0.01
Wealth index	0.11	0.06	0.22	−0.01	1.74	0.08
Life cycle stage	−0.25	0.11	−0.02	−0.47	−2.22	0.03
Occupational diversity	1.26	0.14	1.54	0.98	8.81	<0.01
Farm type (high, non-irrigated)	−0.83	0.28	−0.29	−1.37	−3.00	<0.01
Farm type (high, irrigated)	−1.03	0.26	−0.53	−1.54	−4.04	<0.01

Table 4 Allocation of fish catches to direct consumption vs. cash income generation by wealth group (±95 % CIs)

	Poor	Middle	Rich
Number of households fishing	55	111	44
Proportion of fish consumed (%)	59.51 (±13.26)	57.84 (±9.29)	75.23 (±13.12)
Proportion of fish sold (%)	34.36 (±12.83)	33.47 (±8.88)	17.59 (±11.57)
Mean number of household activities	5.04 (±0.36)	5.65 (±0.20)	6.57 (±0.33)

Discussion

Fishing and Livelihood Diversity

All households conducting fishing activities also undertook additional livelihood occupations in conjunction with fishing. This corresponds with the assertion by Smith *et al*. (2005) that specialisation in inland fisheries happens rarely, if at all, in developing countries and that the majority of households that fish do so as part of a diversified livelihood strategy. This is likely due to limits to scale compared with marine fisheries and the low investment in fishing assets which preserves economic mobility and leaves potential commercialisation underexploited. In addition, fishing was positively associated with higher occupational diversity. This result has also recently been observed in Kenyan marine fisheries where fishers were noted to draw their livelihoods from a higher diversity of occupational sectors and had marginally higher occupational multiplicity than non-fishers (where occupational multiplicity was defined as the sum of the number of occupations held by all household members) (Cinner *et al*. 2010).

The association of fishing activities with households that have higher occupational diversity suggests that providing or facilitating uptake of alternative livelihood activities may not necessarily cause fishers to leave a fishery, and that addition rather than substitution of activities may take place. Pollnac *et al*. (2001) remarked that far from it being a foregone conclusion, the majority of fishers would actually not leave fishing for an alternative occupation, citing income as well as non-income factors as reasons for resisting the change. Studies in Kenya have found no significant relationship between household activity diversification and numbers of fishers, but have concluded that fishers with higher income diversity used more destructive gear, fished more frequently in grounds that were already highly exploited, did not reduce the pressure on the resources and showed no indication of increased willingness to exchange fishing for other employment compared with fishers receiving only one income (Hoorweg *et al*. 2006). Morand *et al*. (2005) described a situation in West Africa where fishing was chosen in preference to previous activities or those practised by their parents and studies on the impacts of seaweed farming as an alternative livelihood for fishers in the Philippines and Indonesia have shown that while fisher

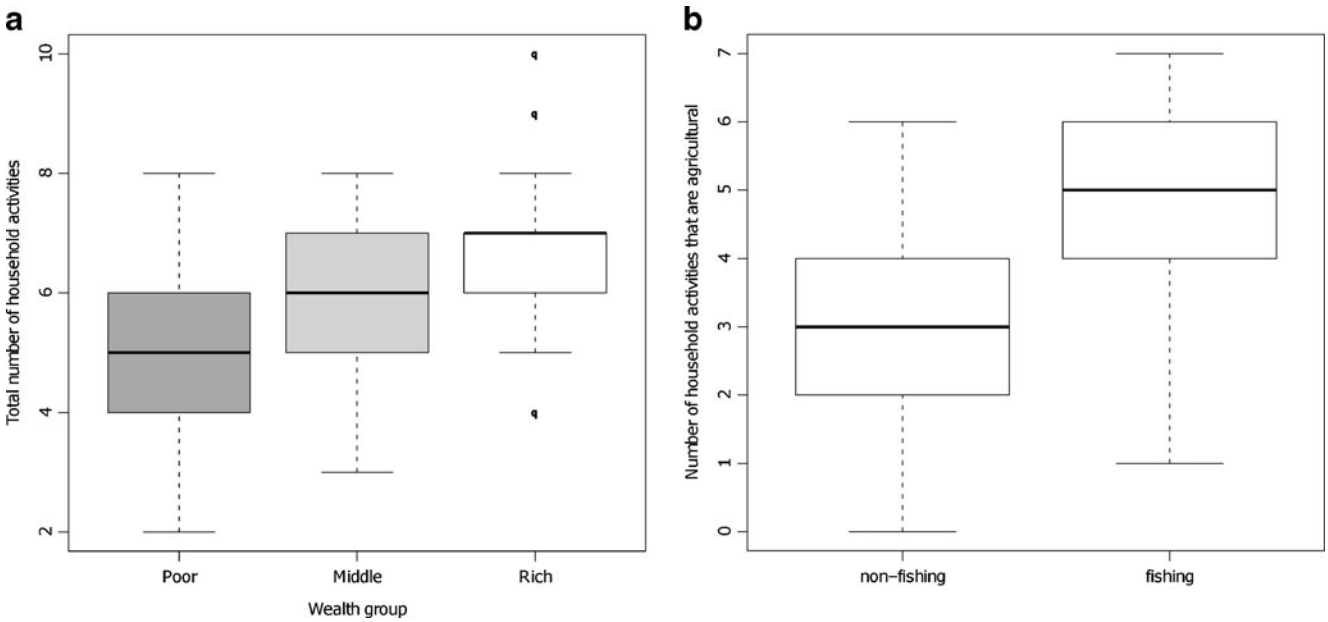

Fig. 3 Number of (**a**) household activities undertaken by poor, middle and rich wealth group fishing households, $n=300$; (**b**) agricultural livelihood activities undertaken by fishing and non-fishing households, $n=519$

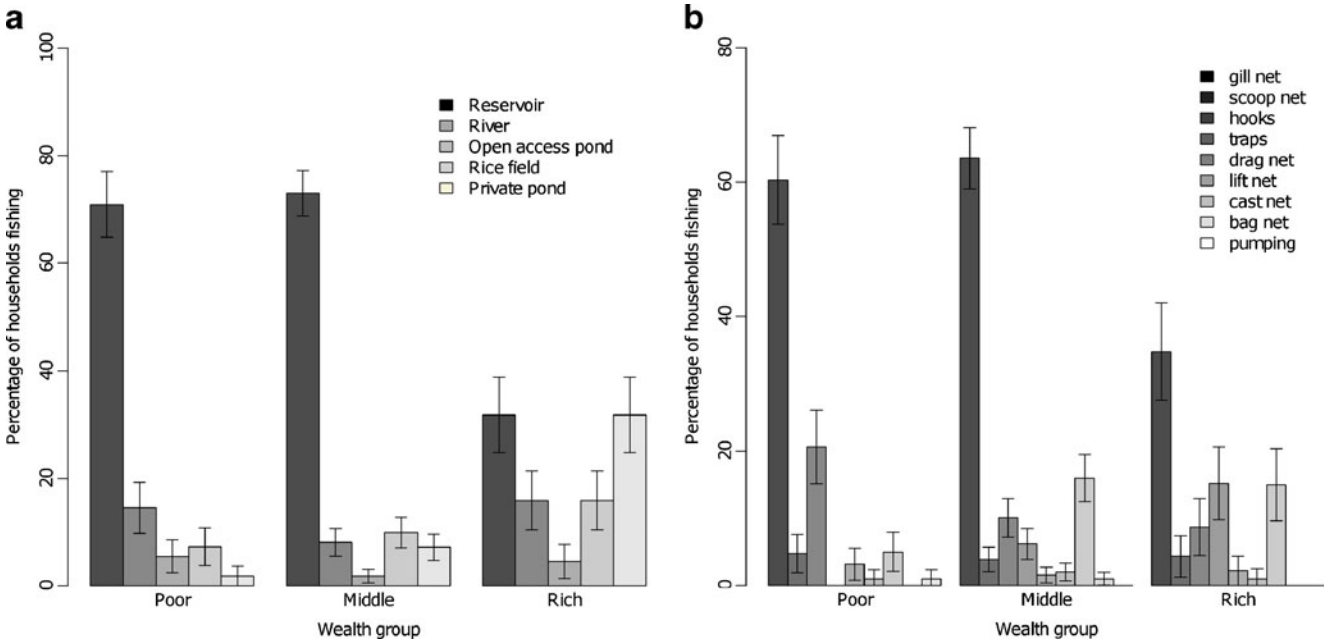

Fig. 4 Households within each wealth group fishing in the previous week (**a**) by waterbody, (**b**) by gear type as a percentage of each wealth group (± 1 s.e.), n=210

numbers and effort may decrease in some cases, results are highly mixed (Crawford 2002; Sievanen *et al*. 2005; Hill *et al*. 2012).

It has been suggested that the risky nature of fishing may cause an association with higher occupational diversity (Cinner *et al*. 2010). Fishing was more common in farms which were subject to frequent over-flooding in the rainy season. This may be partly due to the vulnerability of these farms as end of season flooding has been identified as one of the primary risk factors affecting rice farmers in the region (Chinvanno *et al*. 2008), or it might be a function of the increased fishing area and reduced farming area available. Although there are inevitable trade-offs between fishing and farming in terms of time and investment, results highlight the predominantly synergistic nature of fishing activities within agricultural livelihoods. Fishing was also more common as part of an agricultural livelihood strategy, suggesting particular aspects of agricultural activities make them conducive to parallel fishing activities. Low labour opportunity costs mean fishing is particularly suited to being part of a diversified livelihood strategy. Passive night fishing or part-time fishing combined with other farm tasks both have very low labour and energy requirements, as nets can be left while the fisher is taking the usual rest or undertaking another productive activity such as farming vegetables. Likewise, travel for which the primary purpose was to reach rice fields to farm can provide an opportunity for farmers to check traps or nets in a nearby waterbody. Residential location may provide fishing opportunities through the provision of seasonal or permanent aquatic habitats in which to fish, as may the ownership of rice fields subject to flooding. Garaway (1999) argued that where and when people go fishing is a function of the proximity of other activities of a family and is almost always combined with other activities. As such, fishing is a secondary but extremely prevalent activity. In this way, although the returns elsewhere may not be particularly low, high returns from fishing relative to effort and costs may attract many people to fishing. In cases where these is underutilised rural labour and time, fishing may also form a supplementary occupation in return for sacrifice of leisure time rather than alternative work (Anderson and Deshingkar 2005; Smith *et al*. 2005).

Another aspect of fishing that complements farming is the nature of the output of the resource. Fish provides an instant source of cash for the purchase of food in subsistence/semi-subsistence livelihoods in comparison to the relatively long labour for rice and other arable crops. The low investment costs of gear and boats provides high flexibility, and non-economic aspects of fishing such as pleasure and tradition may be factors preventing households from discarding fishing as an occupation (Crawford 2002). Fishing for recreation has been observed in developing countries where it has been described as ‘filling time’ or ‘playing around at fishing’ in Malaysia (Smith *et al*. 2005), or as ‘relief from the boredom of village life’ for fishers in Papua New Guinea (Lawrence 1991). Farmer-management of aquatic systems in Southeast Asia can enhance fish abundance and catch rates through fishing restrictions, habitat enhancements and use of aquaculture techniques (Amilhat *et al*. 2009a, b; Martin *et al*. 2011). This suggests that

fishing is likely to remain important to rural agricultural livelihoods of both the rich and poor despite agricultural intensification (Nguyen Khoa *et al*. 2005), however, the impact of fishing on resources may be reduced if livelihoods diversification and agricultural intensification lead to people embracing more restricted access regimes, as is indicated by results for the rich group. Also, increasing livelihood diversification in Laos is being accompanied by a trend towards deagrarianisation as the role of non-farm activities grows in importance (Bouahom *et al*. 2004). Given that households that fish are those undertaking a greater number of agricultural activities, there is a possibility that an increase in non-farm work will also reduce pressure on fish resources.

Fishing and Poverty

In Laos, fishing is not synonymous with poverty or dominated by the rural poor, but fishing households are representative of all wealth groups who fish in a variety of locations using different methods and with a diversity of reasons for fishing. This finding corresponds to previous findings in Laos (Garaway 2005) and in Africa, where it has been suggested fishing can play a fundamental role in local economies (Béné *et al*. 2009). A higher percentage of rich households fished in restricted waters which the poor were unable to access, resulting in economic exclusion. Multiple studies have shown that restricted access waters harbour higher fish abundance and provide greater returns to fishing effort (Lorenzen *et al*. 1998; Amilhat *et al*. 2009b; Martin *et al*. 2011). Others, such as traps and scoop nets were low cost but convenient for fishing in rice fields, so were also associated with rich fishers. The poor were more likely to fish with low cost gear such as hooks, and also often used gill nets. In this way, fishing is comprised of many different types of activities which may each be dominated by particular socio-economic groups, although at the aggregate level fishing is fairly ubiquitous across rural communities, regardless of socio-economic status. Fishing contributes to different livelihood strategies in a variety of ways, forming a larger proportion of labour allocation, subsistence and cash income of poorer households. While the rich group consumed more of the household catch, for the poorest households fishing represents a source of ready cash income as fish is sold in order to obtain food security through the cheapest means possible, i.e., purchasing lower priced rice. So although fisheries provide a greater contribution to food security of the poor than the wealthy, the micronutritional benefits of the fish are probably reduced for the poor. The 'cash crop' role provide by these fisheries is similar to the findings from small-scale fisheries in the Congo (Béné *et al*. 2009). This is an important consideration for policy regarding the food security aspects of fisheries, as 'food security' and 'subsistence' are both often used in very narrow terms describing fishers consuming all of their catch, so poorer fishers (who are still 'subsistence' in the sense that they are living at a level of survival) contributing to food security through sale tend to be overlooked (Cunningham and Neiland 2005; Schumann and Macinko 2007).

For wealthier groups, fishing was more often used as a method of providing supplementary, highly desired food items through activities which are complementary to farming activities, such as through fishing in rice fields or ponds in rice fields. Yet in some cases wealthier groups used more efficient and productive fishing methods (such as through the use of private ponds), similar to the inland fisheries of Lake Chad as described by Béné *et al*. (2003). Smith *et al*. (2005) observed that accumulation diversification livelihood strategies may produce this result, suggesting that as incomes rise and households diversify into new higher return activities, fishing may be retained as a supplementary part-time activity, but the income it provides will decline as a proportion of total household income and instead it may be primarily used for own consumption and recreation.

Fishing as an Activity of Last Resort

The relatively low levels of investment required for capture fisheries in Laos give it the potential to become an 'activity of last resort' for households faced with no alternative. However, the results presented here indicate that fishing is associated more with households already undertaking a variety of other activities and that fishing takes place across all socio-economic groups independent of wealth. Of poor households with only one occupational activity, not one listed fishing as that occupation, and households in the vulnerable last stage of the household life cycle were less likely to fish. Households within the final lifecycle stage consist of extremely small families which have few workers. If fishing represents an activity of last resort, then this group would be expected to rely on fishing.

Although fishing is risky and requires hard manual labour, fishing remains an occupation preferred by many in Africa central America and Southeast Asia where alternatives are not lacking (Pollnac and Ruiz-Stout 1975; Allison 2005; Cinner *et al*. 2009). It is widely recognised that fishing can provide non-economic satisfactions in developed countries (Pollnac and Poggie 2006), yet its importance in developing countries is still under-researched. Alongside food and income, enjoyment was often cited as a reason for fishing in this study. Personal satisfaction gained through fishing may be greater than from other productive activities and the utility gained cannot be solely measured in terms of income or compared only to the opportunity cost of labour and other inputs (Smith *et al*. 2005).

Results suggest that fishing is carried out for a range of livelihood objectives beyond those of bare subsistence.

Béné *et al*. (2010) have highlighted the role small-scale fisheries can play in provision of safety nets and the contributions they can make to pro-poor growth, while Allison *et al*. (2004) suggested that fishing actually strengthens diversified livelihoods, and those with access to it are typically better off than those who depend on farming alone in the same locations due to the fact that it is an immediate source of cash that can be used flexibly between different livelihood objectives. In rural Laos it appears that fisheries are used by a range of community members for which they play a varying role in a range of different livelihood strategies. There is still little evidence to show whether an additional livelihood option actually results in a reduction in fishing, and results from this study contribute to the literature suggesting that the development of alternative livelihoods might not be a replacement for other management tools (Hill *et al*. 2012; Sievanen *et al*. 2005), but combined with other approaches may contribute to integrated management supporting both livelihoods and the conservation of natural resources.

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