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Farmer and Nature

Booklet for Family Agriculture Development in Cambodia



EXPERIENCES IN MULTI-PURPOSE FARM DEVELOPMENT:

**RAISING HOUSEHOLD INCOMES IN CAMBODIA
BY UTILIZING PRODUCTIVITY GAINS FROM
THE SYSTEM OF RICE INTENSIFICATION**



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RAISING HOUSEHOLD INCOMES IN CAMBODIA BY UTILIZING PRODUCTIVITY GAINS FROM THE SYSTEM OF RICE INTENSIFICATION

Prepared by **Lim Soviet**
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I also thank CEDAC staff members who have provided useful advice to inform this document, especially Mr. Suon Seng, Mr. Or Thy, Mr. Reach Sopheap, and Mrs. Pean Sokha. I would like also to thank Mr. Chay Keartha and Ms. Hay Leakhena, who have carried out case studies necessary to complete this document.

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This document still has some weaknesses in terms of pictures and its content. Therefore, CEDAC would appreciate any comments or impressions that you may wish to contribute to further improvement of this booklet. Thank you for your time in reading this document.

Lim Soviet

PREFACE

Through its field work and experience with Cambodian farmers over the last 10 years, CEDAC know that farmers' ability for sustain and improve food supply and income generation is still a big problem at present. Small-sized rice fields, low productivity, and growing only rice are serious constraints on reducing poverty in rural areas of Cambodia.

Over the past 10 years, CEDAC has been conducting studies and working cooperatively with farmers in order to find suitable ways to deal with these problems. CEDAC has published, in sequence, technical documents on Home Gardening, the System of Rice Intensification (SRI), and other subjects. Through the application and combination of innovations, farmers have been able to deal with their families' food and nutrition supply. Nevertheless, farmers are still facing some shortages of protein food (fish and meat), of firewood, and of organic matter for improving soil quality, because of the low productivity of their agricultural land, especially their rice fields.

Responding to these needs, a document on **Experiences in Multi-Purpose Farm Development** has been prepared to contribute to increased productivity of rice fields and farming systems as a whole, thereby increasing opportunities for income generation for farmers and their families. Multi-Purpose Farm (MPF) development is a concrete example of integrated farming systems that combine rice production with fruit trees, multi-purpose trees, perennial crops, vegetables and seasonal crops, animals, and fish. This document has been compiled from the experiences of farmers who have been collaborating with CEDAC, especially around the challenge and opportunity of *successful MPF development*.

This document on *Experiences of Multi-Purpose Farm Development* will be disseminated and used for supporting farmers to become successful in MPF development, as many as possible in Cambodia through the development projects of CEDAC and partner NGOs. We hope that this document will help farmers to increase their agricultural productivity for improving family food supply, enhancing nutrition and health, and generating additional family income.

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I. INTRODUCTION

Cultivation on homestead land and rice fields plus the collection of natural resources (e.g., fishing and non-timber forest products) and non-farm activities that earn additional family income are the main sources of food supply and income for rural farmers and their families in Cambodia.

Cultivation is the predominant source of food supply and income generation, so **agriculture** is the main occupation for rural households. They focus much of efforts on their homesteads and their rice fields, seeking to achieve a degree of *self-reliance* and to ensure livelihood *sustainability* consistent with their living situations and existing resources. However, their area of land for cultivation is usually very small, which sets serious constraints on their well-being and satisfaction.

About 75% of Cambodian people are rice-based farmers. Many farmers are not able to produce sufficient rice to meet the consumption needs of their families, making other activities necessary for subsistence. When farmers grow only rice and grow it only once a year (in the rainy season), there is low household income and much insecurity. Those who increase their use of and dependence upon chemical fertilizers often see their soil quality decrease over time, having lower rice yields rather than more; and in any case, their costs of production become increasingly difficult to meet. Moreover, as population size grow, there is shrinkage in the size of household land holdings, making it more and more difficult for farmers to produce enough food to meet the needs of their families.

To improve this situation, CEDAC has been supporting ‘ecological agricultural techniques’ that enable farmers to increase and sustain more intensive productivity from their limited land resources. In particular, CEDAC has introduced methods such as the System of Rice Intensification (SRI) starting in 2000 and Multi-Purpose Farming (MPF) since 2001. MPF converts the layout and use of specific rice fields into an *integrated farming system* through the *diversification* of agricultural items and productivities. MPF includes many kinds of production such as rice, crops, vegetables, fruit trees, multi-purpose trees, animals, fish, firewood, fodder, medicinal plants, etc., going from monoculture to a dynamic, well-managed polyculture.

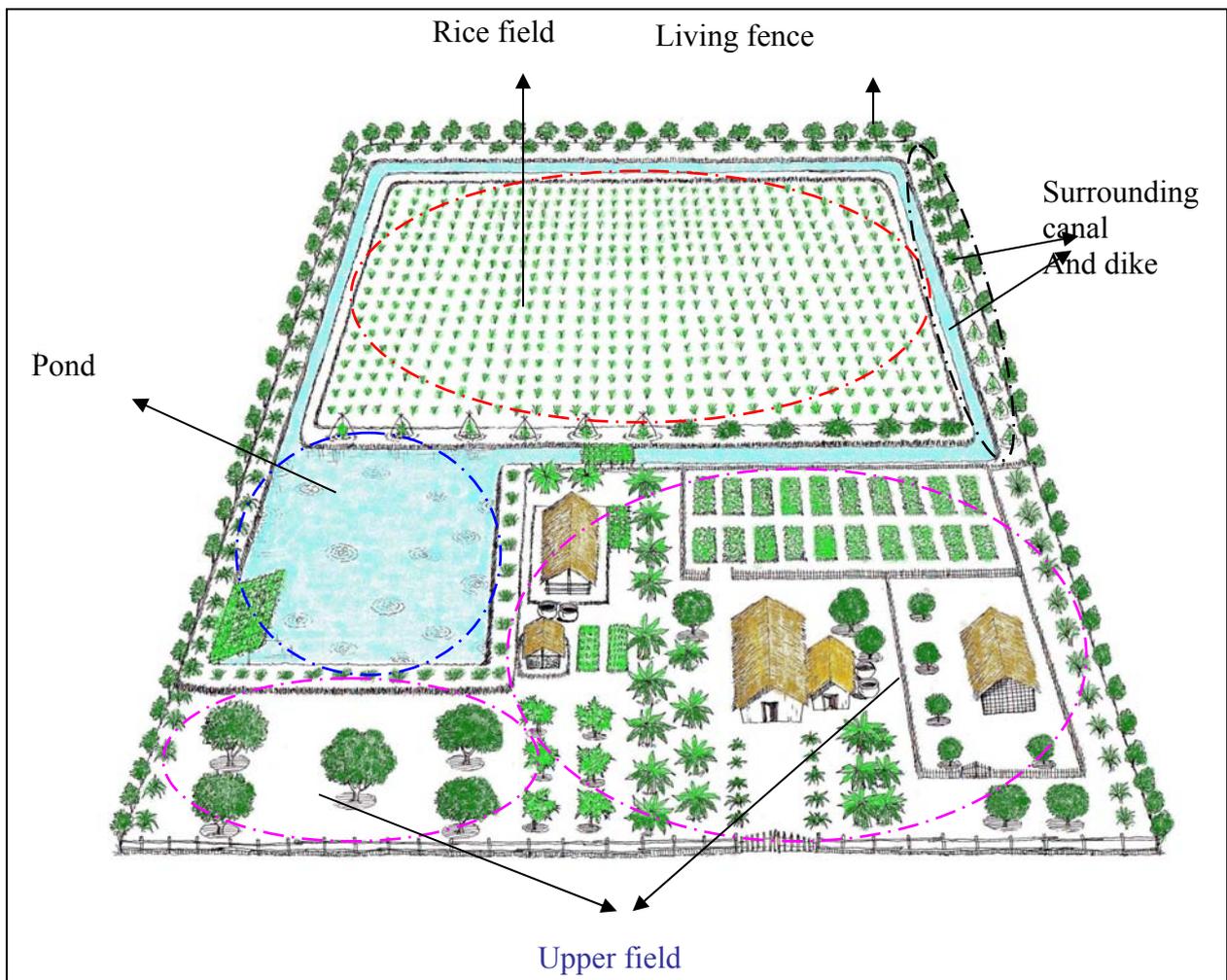
A growing number of farming families have decided to convert their rice fields into MPF, diversifying production beyond the familiar rice cultivation. Due to a lack of effective resources and knowledge, some farmers have failed in their MPF designs and efforts, which is unfortunate, while others were not completely successful, also unfortunate. To date, only a small number of farming families have been successful in developing MPF in Cambodia. However, those who have succeeded in this transition, have been very successful indeed. Learning from their experience and example can benefit many other households that are willing to intensify their farming system management in order to gain greater productivity and security.

This document on farmers’ experiences in developing MPF has been initiated, studied and compiled by CEDAC. It was produced through interaction with 15 farmers in different provinces who have effectively converted their small rice farms to MPF. Of these, 5 have been the *most successful* MPF farmers, and they have participated in preparing case studies that form the main basis for this document.

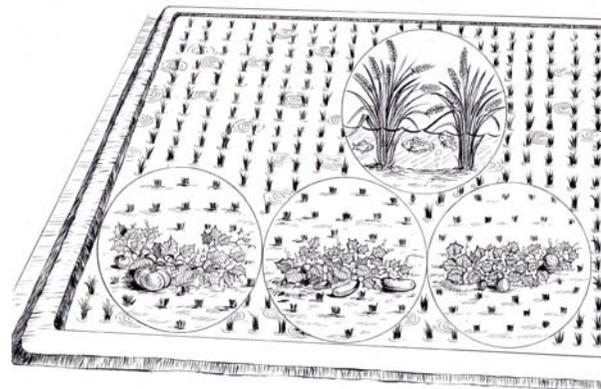
II. GENERAL ASPECTS OF A MULTI-PURPOSE FARM

2.1. What is a Multi-Purpose Farm?

A Multi-Purpose Farm (MPF) is the concrete practice of an integrated farming system which includes rice production, fruit trees, multi-purpose trees, perennial crops, vegetables and seasonal crops, appropriate animals, and fish. This system is designed to convert certain rice-field area to enhance agricultural productivity of the whole area. MPF is a system for improving and ensuring the sustainability of farmers' livelihood, especially for small-holding rice farmers (with fields from 0.2 to 0.6 ha) who cannot otherwise produce enough food to support their families.

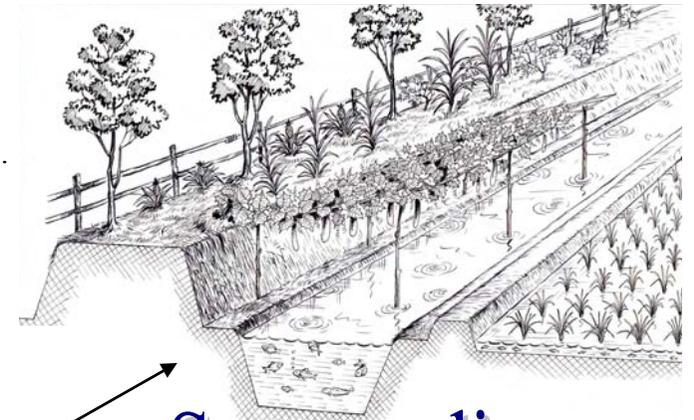


Picture 1: General view of a Multi-Purpose Farm

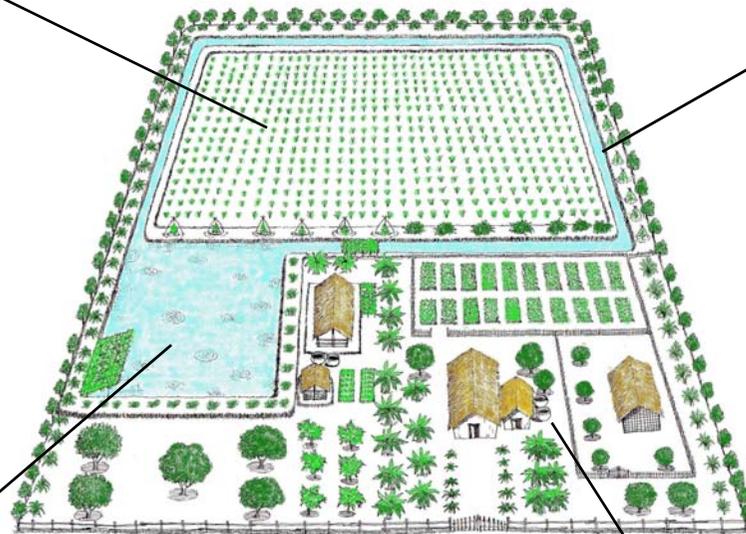


Rice field

A general views or basic plan of Multi-Purpose Farm:
Rice field, pond; upper field; surrounding canal and dike.

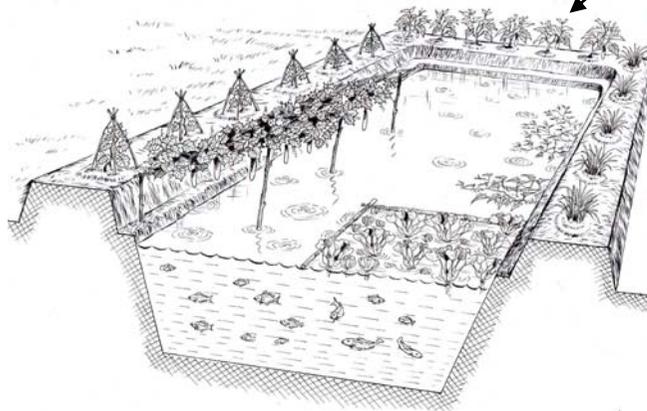


Surrounding canal and dike

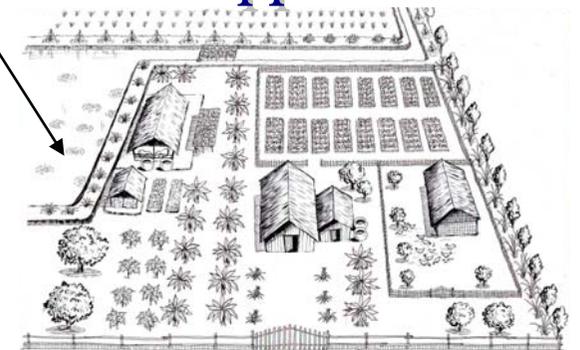


Pond

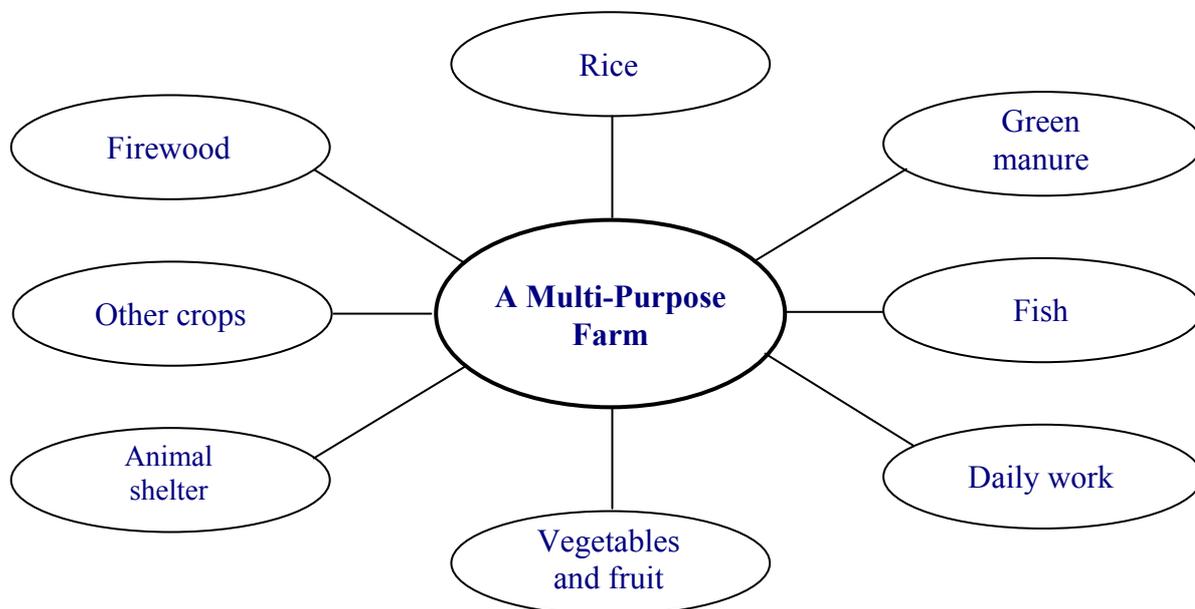
Upper Field



Picture 2: A g eneral view and basic plan of
a Multi-Purpose Farm



A Multi-Purpose Farm (MPF) produces a large number of products for farming families. It provides a higher rice yield with SRI as well as yielding vegetables, fruit and other crops, fish, firewood, fodder and green manure and giving animals food and shelter (from natural enemies). It becomes site providing year-round profitable work opportunities for farmers.



Picture 3: Products received from Multi-Purpose Farm

2.2. Principles and techniques of Multi-Purpose Farm development

2.2.1. Rice field management

Rice fields in MPF remain about 50% to 60% for the area in MPF. With SRI methods, 0.5 ha of rice field should produce enough rice for a family year-round. The proportion in rice fields can remain larger than 50-60% if the MPF area is small, of course, but with good use of SRI methods, which enhance soil fertility over time, the size of the rice field can be even smaller than 0.5 ha (see Table 2).

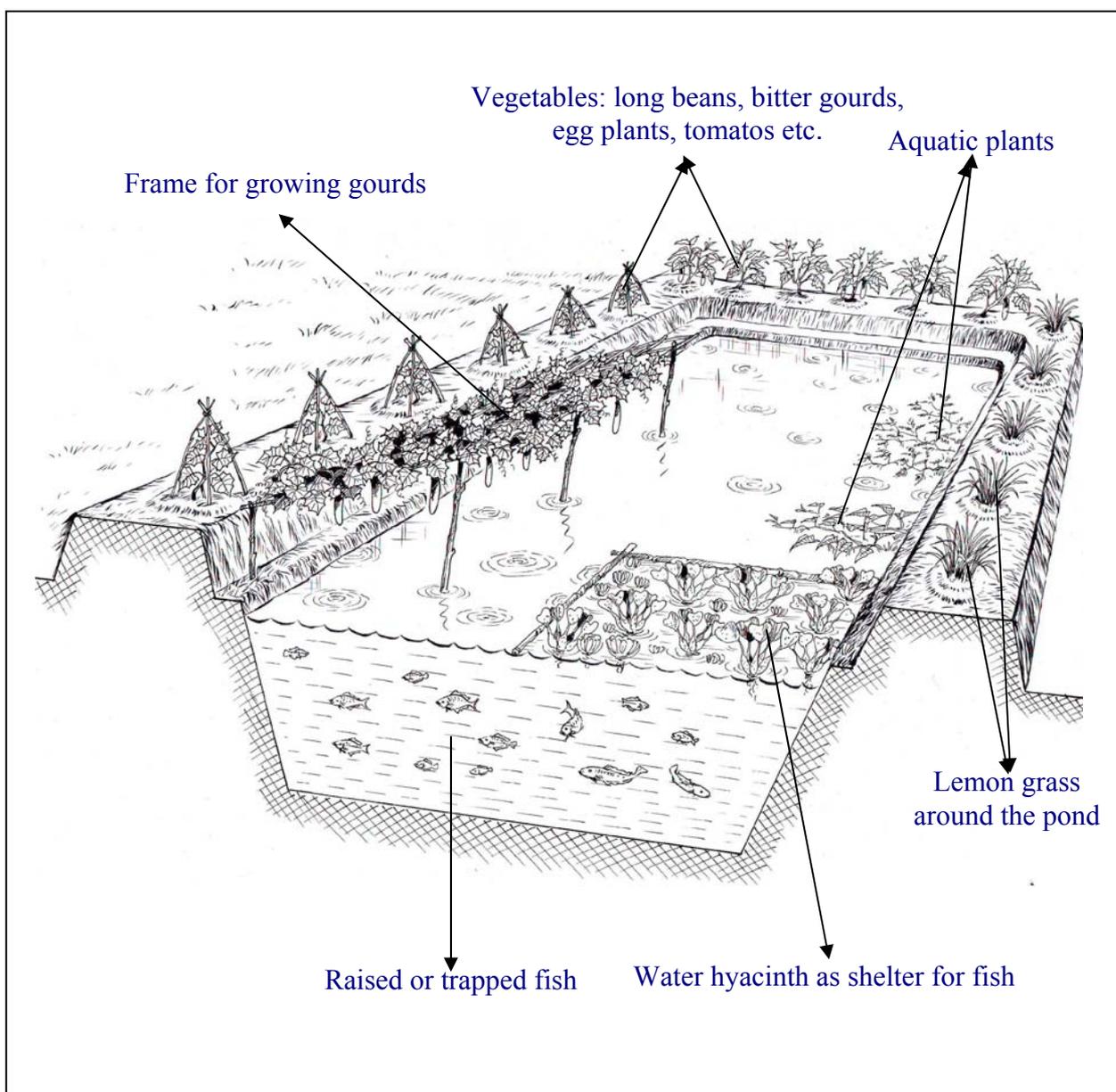
Rice fields play a crucial role in producing sufficient rice for farmers' families. Rice fields in MPF can be smaller than before because they can producing yields 2-3 times higher than before, once soil quality has been improved and water is well managed. For MPF, SRI should be well applied in the remaining rice area, with fish production added as a core activity, along with growing other crops such as watermelons, cucumbers, pumpkins, etc. for supplementary vegetable production along field borders and growing other plants such as mung beans or other legumes as green manure.



Picture 4: Rice field in Multi-Purpose Farm

2.2.2. Pond preparation

On average, the size of the pond in MPF is 10 m x 15 m or bigger, with depth of 2 to 3 m. In a MPF there should be at least one pond, but possibly more. The number and layout will depend on farmers' space and design. The pond plays an important role in storing water for a variety of purposes, including growing crops, saving rice during short drought periods, and assisting farmers to grow many kinds of plants as vegetables, including aquatic ones.



Picture 5: Preparation of pond in Multi-Purpose Farm

The digging of ponds should be carefully carried out to prevent the water from becoming filled with sediment and to keep the soil from eroding in the first year. The wall of the pond should have a proper slope with a surrounding dike that is built 0.5 m from the pond side (leaving 0.5 m interval for grass or growing *Sesbania rostrata*). Once there are grasses or other plants growing on the bunds around the pond, the soil will be stabilized. There needs also to be a few holes in the dike to enable fish to move in or out of the pond. These should be prepared and connected to the canal.

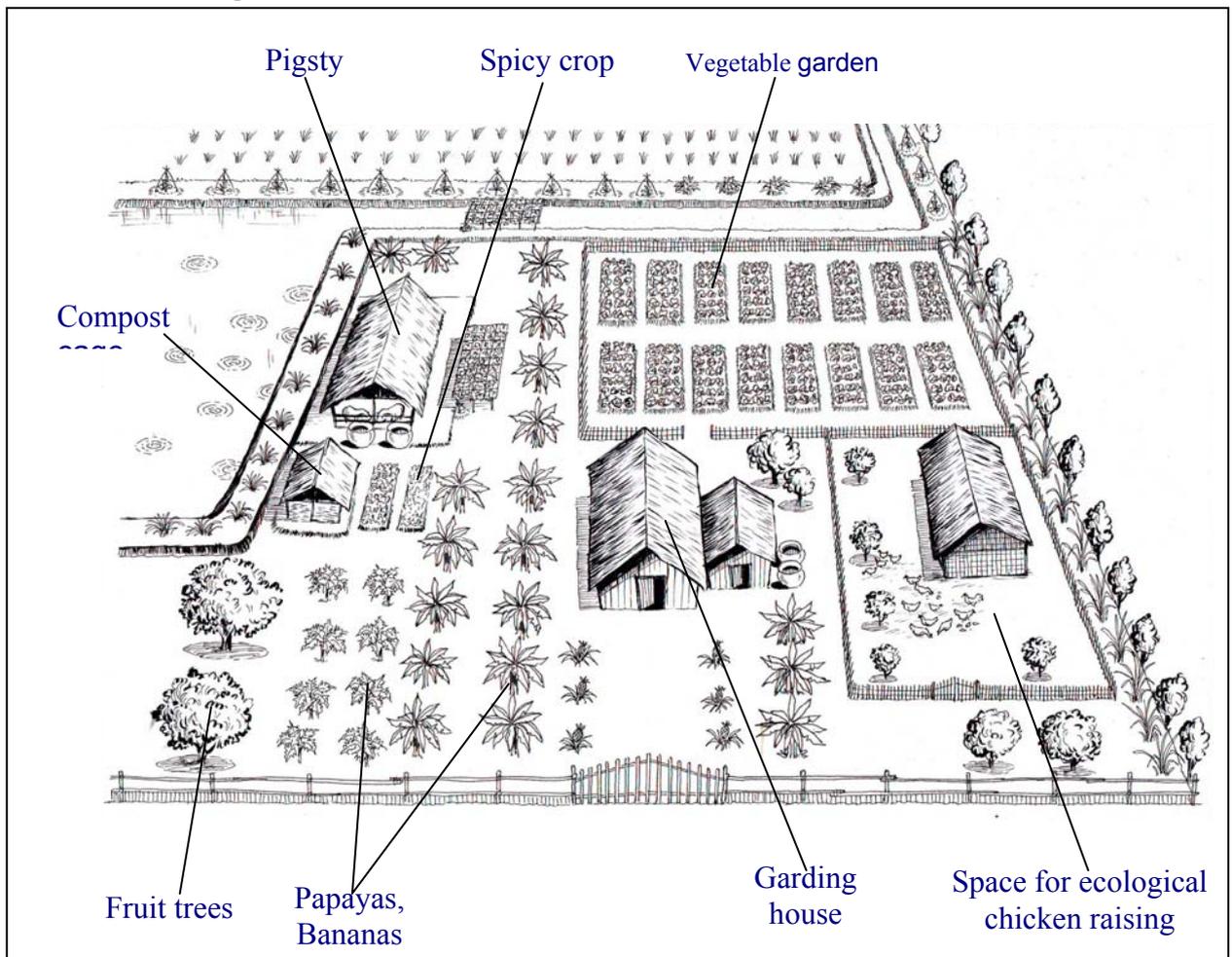
Farmers need to have a clear plan for the preparation and construction of ponds. Construction should be commenced late in the dry season, around February-March. This timing is important to complete the digging before the rainy season comes. If farmers are late in completing their digging, the functioning of their pond will be delayed for one year.



Picture 6: Ponds in farmers' Multi-Purpose Farm

2.2.3. Upper field preparation

The upper field should be laid out adjacent to the pond, using the soil excavated from digging the pond as this will provide more soil depth for growing other crops. This area is planned for integrated production of crops and animals, so farmers will plant fruit trees, perennial plants, vegetables, and spices there, as well as use it for raising pigs, chickens, ducks, etc. These upper fields are commonly places where farm-owners will construct a guard house or watch house to protect their plants and animals and to facilitate their intensified management in a comfortable manner.



Picture 7: Upper field preparation in a Multi-Purpose Farm

Some farmers are most interested in growing annual/seasonal crops on the upper fields of their MPF. This enables their MPF to produce some income all year-round, especially in the dry season (despite water shortage – because there is reserve water in the pond). Farmers should think carefully to include all or some fruit trees, perennial plants, annual/seasonal crops and spices to achieve year-round production of their MPF. Market opportunities as well as agronomic factors will influence these decisions.



Picture 8: Mixed cropping of papayas and chilies on upper field Multi-Purpose Farm

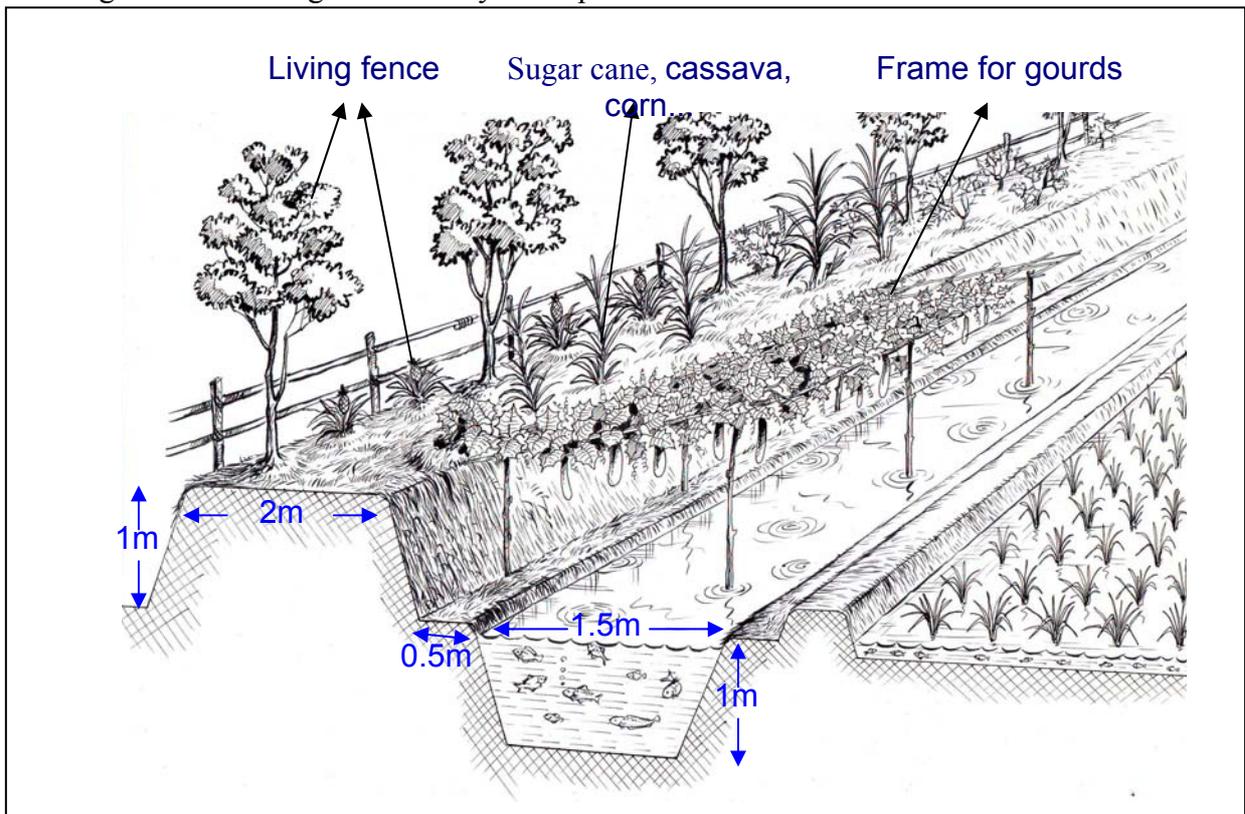


Picture 9: Mixed cropping on an upper field Multi-Purpose Farm

2.2.4. Surrounding canal and dike preparation

Surrounding canal: An appropriate size for this is 1.5 m width, with sloped walls, and 1 m depth. If farmers do not have enough capital (money or labor), they can start with a canal on just one side of their MPF and this canal can be made bigger and deeper rather than have a surrounding canal that is smaller and shallower.

Surrounding dike: This should be built by using the soil from digging a canal. The dike around the MPF should be 1 to 1.5 m height and 2 to 3 m in width with appropriate sloped walls and grassed-over surface. This dike will protect fish and nutrients from going out of the farm, and will also prevent minor flooding. Farmers can plant multi-purpose trees as a living fence and can grow a variety of crops on the inner side of the dike.



Picture 10: The design of surrounding canal and dike in a Multi-Purpose Farm

The digging of a canal should be well-done in the same way as the pond in order to protect the soil from erosion in the first year. Farmers must be careful in building the surrounding dike to minimize conflict with neighboring rice fields. This all sounds like a lot of work, but the economic benefits, evaluated below (section 2.5), justify the investment of time and effort. This transformation is intended to be one which requires minimum capital resources so that it will be accessible to resource-limited farm households.



Picture 11: Canal and dike in farmer's Multi-Purpose Farm.

2.3. Progress of Multi-Purpose Farm under the support of CEDAC

CEDAC has introduced and disseminated SRI methods since 1999, and this system started to be adapted and applied by farmers in 2000. SRI is a combination of good techniques and practices for assisting rice to grow well and produce higher yields according to the rice plants' natural potential. The application of SRI requires farmers to prepare the proper conditions for rice plants' effective growing and tillering to achieve high yields, soil improvement, and water management and saving. In this booklet, we are focusing on MPF rather than SRI, taking SRI as a given. Information on SRI can be obtained from CEDAC or from the web (<http://ciifad.cornell.edu/sri/>).

Early on, with the support of CEDAC's knowledge and techniques, some farmers started converting and developing their rice fields into what we now understand as a System of Intensification and Diversification (SID). This they achieved through the digging of canals, building higher surrounding dikes, making 'living fences' by planting multi-purpose trees, digging small ponds to increase water sources, and by growing additional crops on the dike, in upper fields and in rice fields as an intercrop, etc.

This system has been improved sequentially into Multi-Purpose Farming. Farmers have well-designed plans on their farm. In MPF, farmers retain around 50% of their land area for their rice field, and other spaces are transformed by higher and larger surrounding dikes with deeper and larger canals around rice fields, or by dividing the farm into two or three parts, with ponds for storing water and aquaculture production and upper fields for mixed varieties of crops and fruit trees as well as animal raising. The upper field is made more productive by using the soil taken from the digging of the pond.

CEDAC has introduced and disseminated MPF innovations to farmers since 2001. From year to year, the number of farmers who have begun developing MPF has been increasing. Almost 400 families are currently developing MPF systems as seen in Table 1.

Table 1: Progress of Multi-Purpose Farm with the support of CEDAC

Province	2002	2003	2004	2005	2006
Takeo	35	37	37	40	45
Prey Veng	158	162	182	200	215
Kampong Cham	23	23	36	36	40
Kampong Speu	0	10	36	40	49
Kampong Thom	1	1	1	1	12
Svay Rieng	0	0	32	35	36
Total	217	233	324	352	397

2.4. Farmers' experiences in designing Multi-Purpose Farm

Based on the successful experience of 5 farmers in the development and design of MPF, we are assuming that the average land size (rice field) for developing MPF is 66.64 ares (0.66 hectare, or 1.65 acre). This area is divided into three main parts:

- The rice field is 42.8 ares (0.43 hectare),
- Area for water sources including pond and canal is 8.78 ares (0.09 hectare), and
- Area for some combination of mixed crops and animal raising, including the upper field and surrounding dike is 15.06 ares (0.15 ha).

Note: As seen from Table 5 below, this calculation, with breakdown in Table 2, is based on an average for 5 farmers' experience. One of these five has a land area about four times larger than the other four, so the average total area for most of the successful MFP farmers is actually 43.8 ares, less than half of a hectare. This strategy can thus be utilized by households with very small landholdings.

Table 2: Average land size to be developed and designed Multi-Purpose Farm

	Total space	Rice field	Pond and canals	Upland area and dike surfaces
Average size (ares)	66.64	42.8	8.78	15.06
Percentage (%)	100%	57.24%	15.12%	27.64%

Note: 1are=0.01ha

2.5. Investment and income of Multi-Purpose Farm development

Normally, the development of rice fields into a Multi-Purpose Farm requires farmers to make some investment at the first stage when they have some money and/or labor time to invest, specifically for making/digging ponds and canals, building higher and bigger surrounding dikes, and preparing upper fields for mixed cropping and animal raising, and especially the making of fences around the farm. With higher-value production which can be more easily stolen than rice from a paddy field, it is necessary to secure crops, animals and fish.

The scale of the investment budget can be higher or lower depending on the ability of farmers and whether they are investing mainly money or their own labor. According to farmers' experiences, the average amount of money invested for developing a MPF is around 1,200,000 riels (about 300 USD).

Through that first investment, farmers must pay attention to harvesting or getting a return from their MPF as soon and as much as possible. They should have enough ability to increase their crop growing and animal or/and fish raising. Skilled farmers can harvest and get a return large enough to settle the investment usually by the second or third year of MPF development. This is actually a very good return on investment.

Table 3: Investment and income of Multi-Purpose Farm development

	Average annual income without MPF	Average annual income with MPF	Total average of investment for MPF development
In Riel	763 600	2 395 000	1 219 800
In US dollar	190.9	598.75	304.95

Note: 1USD=4000riels

2.6. Farmers' received benefits

The productivity of MPF is many times more than the economic benefits reported in Table 3 if we compare its productivity with the same-sized rice field because MPF does more than simply increasing rice output. It produces also many kinds of products such as fish, meat, vegetables, fruit, firewood, and fodder. The economic benefits reported in Table 4 below cover only income from market sales, almost 10 times more than before. They do not include home-consumption from the increased and diversified farm production, which improves household members' diet with more meat, fish, fruits and vegetables, thereby enhancing their health and vitality.

Moreover, MPF provides other benefits such as improving soil quality, eliminating the use of chemical fertilizers, protecting against soil erosion through the diversification of crops, and making greener landscapes. It also helps in conserving bio-diversity such as increasing shelter for beneficial animals (e.g., natural enemies that play an important role in protecting crops from pests).

Through our study with the 5 best MPF farmers, we can compare the productivity of the average benefits of rice field area with and without MPF as follows:

Table 4: Income from selling products before and after Multi-Purpose Farm

		Before MPF	After MPF
Land size (ares)		66.6	66.6
Selling rice	In riels	100 000	206 900
	In USD	25.00	51.72
Selling vegetables	In riels	0	836 500
	In USD	0	209.12
Selling fish	In riels	30 000	192 200
	In USD	7.50	48.05
Selling animals	In riels	0	101 000
	In USD	0	25.25
Other: Hosting exchange visits etc.	In riels	30 000	238 600
	In USD	7.50	59.65
Total	<i>In riels</i>	<i>160 000</i>	<i>1 575 200</i>
	In USD	40	393.8

III. FARMERS' EXPERIENCES OF SUCCESSFUL MULTI-PURPOSE FARM DEVELOPMENT

The results presented above are reported from the experiences of the 5 best farmers who have succeeded in MPF development in cooperation with CEDAC staff.

Table 5: List of farmers who succeeded in Multi-Purpose Farm development

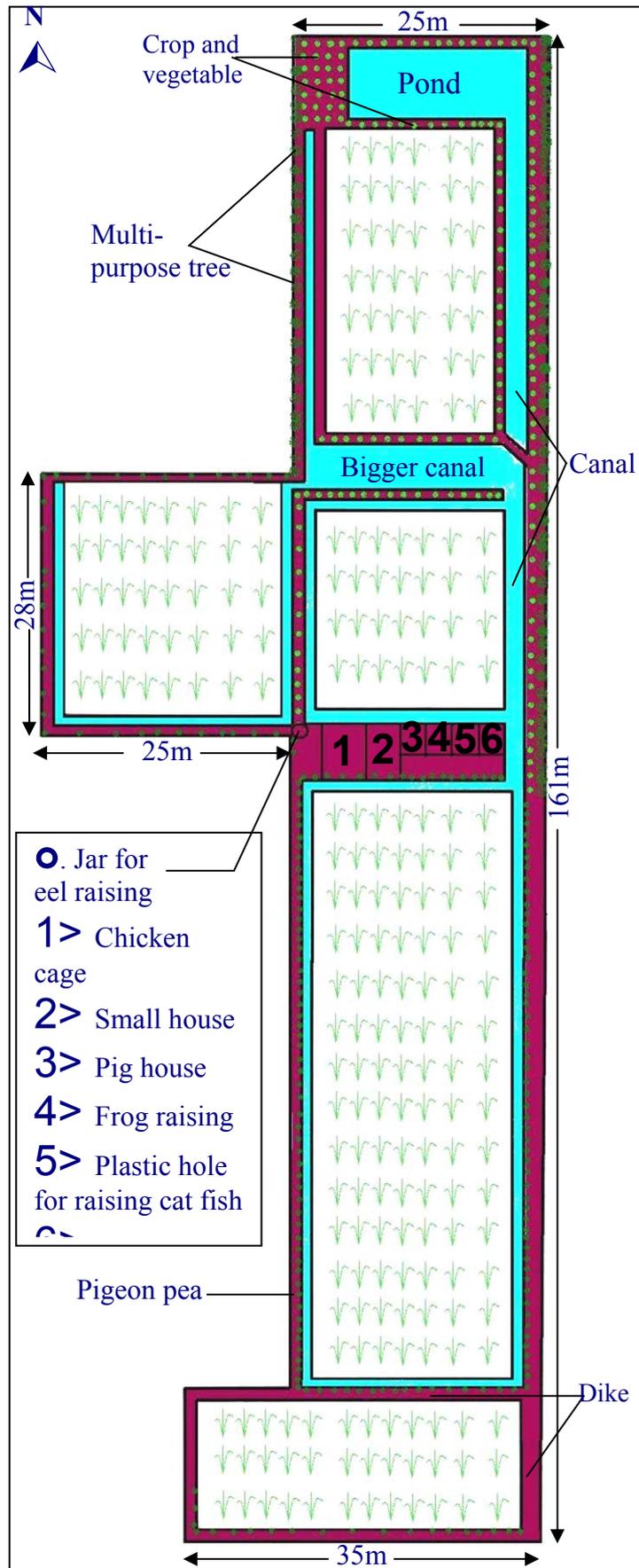
N°	Name	Sex	Village	Commune	District	Province	Size of MPF (are)	Year started
01	Roas Mao	M	Chormpul	Popel	Tramkak	Takeo	48.3	2003
02	Um Sun	M	Ang Raing	Boeng Tranh Cheung	Samrong	Takeo	23.5	2004
03	Prak Chres	M	Tasuon	Trapaing Thom Cheung	Tramkak	Takeo	44.5	2002
04	Mao Pheng	M	Hob	Kork Kchork	Kampong Trabek	Prey Veng	55.0	2003
05	Teab Leng	M	Samnoy	Senareach Oudom	Prah Sdach	Prey Veng	162.0	2005

3.1. Land use experiences of farmers

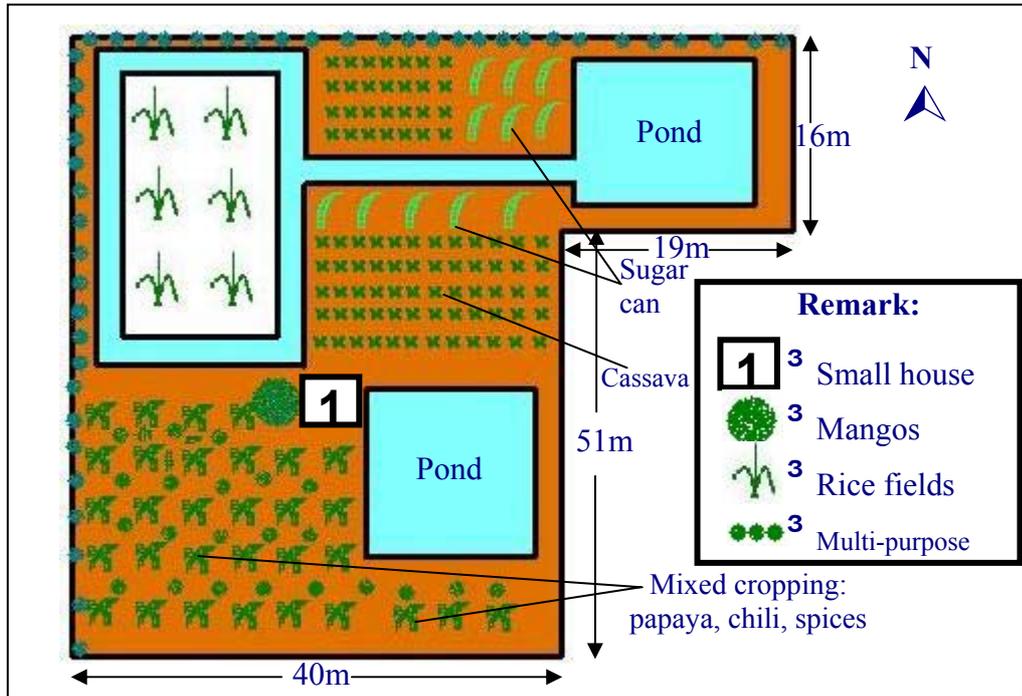
The design of MPF plans is quite varied. It depends particularly on the desire and creativeness of farmers themselves. Some farmers have retained bigger areas for their rice production, while other farmers have retained smaller areas for their rice fields by using other spaces to make ponds, canals, dikes and upper fields. The following are the different designs of MPF from the 5 best MPF farmers:

Table 6: Land uses of farmers in Multi-Purpose Farm development

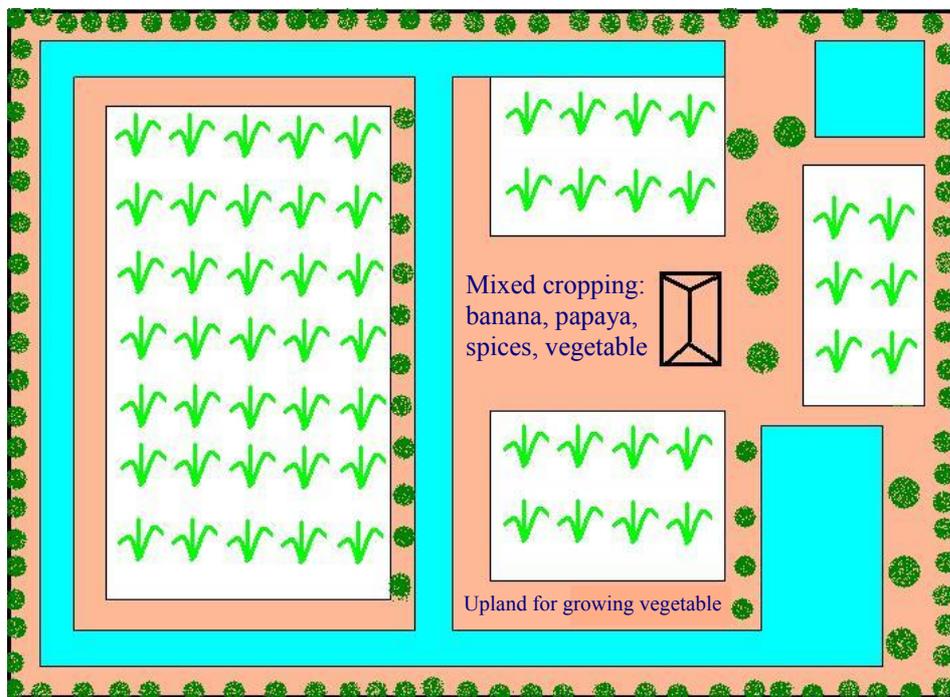
Farmers' Name	Total space		Rice field		Space for pond and canl		Space for upland and dike	
	Ares	%	Ares	%	Ares	%	Ares	%
Roas Mao	48.3	100	32.0	66.3	7.4	15.3	8.9	18.4
Um Sun	23.4	100	3.7	15.8	5.8	24.8	13.9	59.4
Prak Chres	44.5	100	28.0	62.9	7.5	16.9	9.0	20.2
Mao Pheng	55.0	100	40.3	73.3	3.6	6.5	11.1	20.2
Teab Leng	162.0	100	110.0	67.9	19.6	12.1	32.4	20.0



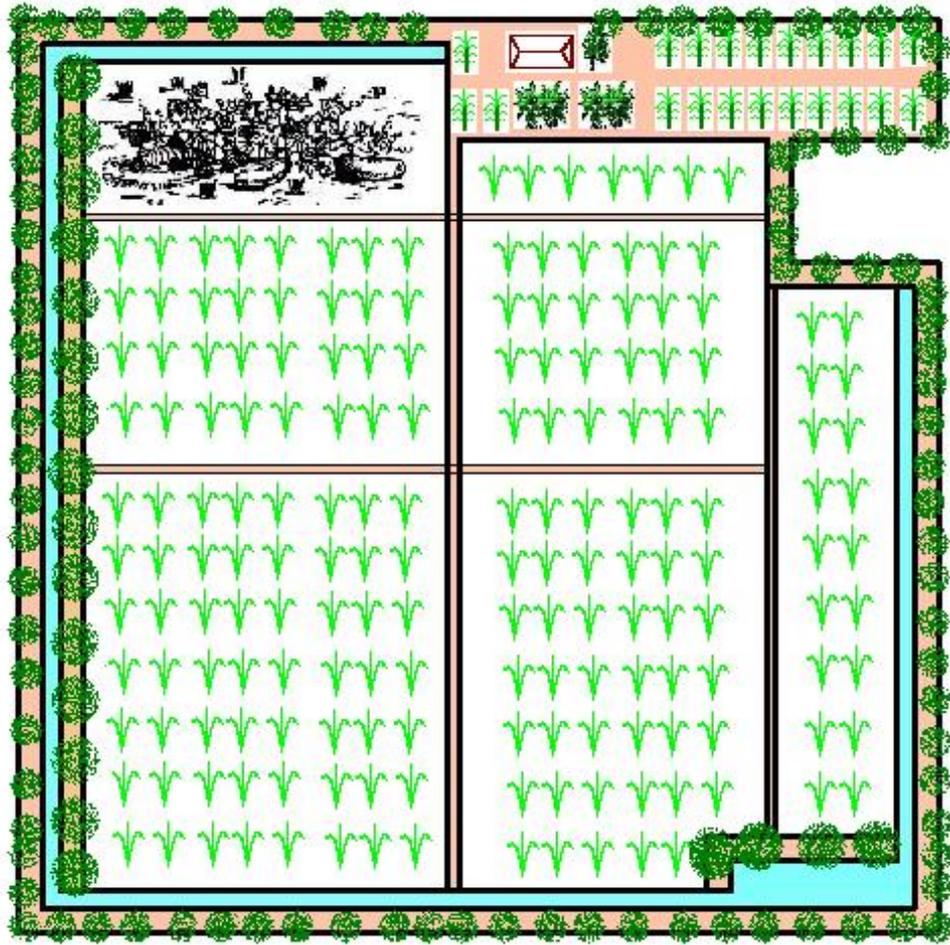
Picture 12: Land uses of developed Multi-Purpose Farm of Mr.Roas Mao



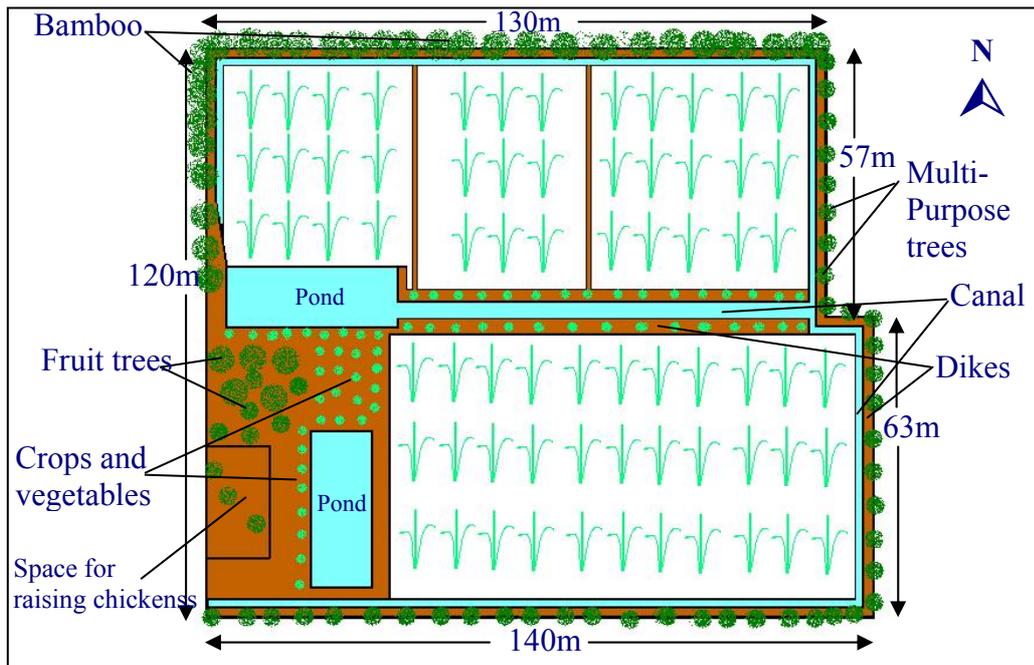
Picture 13: Land usage of developed Multi-Purpose Farm of Mr. Um Sun



Picture 14: Land uses of developed Multi-Purpose Farm of Mr. Prak Chres



Picture 15: Land usage of developed Multi-Purpose Farm of Mr. Mao Pheng



Picture 16: Land usages of developed Multi-Purpose Farm of Mr. Teab Leng

3.2. Farmers' experiences in designing each plot of Multi-Purpose Farm

From a specific rice field, farmers could convert/develop into many plots in order to increase the abilities for growing other crops/plants, raising fish and animals. The main objective is to intensify the productivity of each plot as much as possible. We can learn from the experiences of some farmers in designing and preparing each plot of MPF. They are as follows.

Table 7: Farmers' experiences in designing each plot of Multi-Purpose Farm

Farmer	Rice field	Pond	Upper Field	Canal and dike
Roas Mao	<ul style="list-style-type: none"> - Applies SRI methods effectively - Grows watermelons and green gourds before and after rice - Uses only organic fertilizer, with no use of agrochemicals 	<ul style="list-style-type: none"> - Grows lemon grass around the pond and also aqua-plants - Made frame over the pond for growing gourds - Raises fish in pond - Has proper pond slope 	<ul style="list-style-type: none"> - Has two upper field plots; one for growing vegetables and the other for raising animals - Built small house for guarding the farm - No large fruit trees due to the small space available 	<ul style="list-style-type: none"> - Larger and deeper canal connected to the pond - Made frame over the canal for growing gourds - Made hole for fish to go into and out of the rice field - Larger and higher dike with fence, planting pigeon peas as well as many other crops such as sugar cane and cassava, etc.
Um Sun	<ul style="list-style-type: none"> - Retains smaller rice field than others - Has canal around rice field to do rice-growing and fish raising - Applies SRI methods effectively to produce higher yields 	<ul style="list-style-type: none"> - Made two ponds for raising fish - Prepared proper slope for the pond and planted lemon grass around the pond 	<ul style="list-style-type: none"> - Has three upper field plots with wider spaces - Planted mixed papayas, chillies and spices that can earn income for long time - Planted other crops such as sugar cane and cassava, etc. 	<ul style="list-style-type: none"> - Has surrounding dike but one side is still low - Planted multi-purpose trees, but these are not yet large - Has canal around the rice field connected to the pond
Prak Chres	<ul style="list-style-type: none"> - Applies SRI methods effectively - Constructed canal around rice field for good water management 	<ul style="list-style-type: none"> - Has two large ponds - Did good preparation to prevent soil erosion - Made fish-trapping ponds 	<ul style="list-style-type: none"> - Made wider space for upland production - Planted many mango trees - Grows a lot of vegetables and crops for all year-round production 	<ul style="list-style-type: none"> - Built larger and deeper canal around the rice field and in the center of the farm - Prepared a fish trapping system - Has larger and higher surrounding dike with a living fence
Mao Pheng	<ul style="list-style-type: none"> - Applies SRI methods effectively - Grows dry-season rice and green gourds on rice fields - No chemicals used 	<ul style="list-style-type: none"> - Has a small pond which can trap fish 	<ul style="list-style-type: none"> - Has large enough upper field for growing many kinds of vegetables and crops 	<ul style="list-style-type: none"> - Built a larger and higher dike around the farm with a living fence, and a canal around the whole farm
Teab Leng	<ul style="list-style-type: none"> - Retained larger rice field - Grows short- 	<ul style="list-style-type: none"> - Has two big ponds for storing water for all year round 	<ul style="list-style-type: none"> - Has wider upper field land for planting many fruit 	<ul style="list-style-type: none"> - Built larger and higher dike around the farm with a living

duration rice and cucumbers on rice fields in early rainy season before rainy-season rice - Applies SRI methods effectively	- Raises fish and grows aqua-plants - Grows lemon grass around the pond with well-designed preparation	trees, mixed crops and vegetables - Prepared a double fence for ecological chicken raising	fence - Has larger and deeper canal around the farm
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3.3. Investment and income of Multi-Purpose Farm development

According to the different designs of MPF for each farmer, the amount of investment and income is also different from one to another. We can see that more space that farmers convert into water sources and upper fields, including a commitment to grow a variety of crops, the higher income they can earn compared to others. Mr. Um Sun has retained a very small rice field, but he could earn the highest income from his MPF compared to the other 4 farmers.

Table 8: Investment and income of Multi-Purpose Farm development

Farmer		Income before MPF (average/year)	Income after MPF (average/year)	Investment
Roas Mao	In riels	286,000	2,943,300	450,000
	In USD	71.50	735.80	112.50
Um Sun	In riels	770,000	3,309,000	1,635,000
	In USD	192.50	827.30	408.80
Prak Chres	In riels	1,896,000	2,601,000	1,800,000
	In USD	474.00	650.30	450.00
Mao Pheng	In riels	320,000	1,816,800	146,000
	In USD	80.00	454.20	36.50
Teab Leng	In riels	546,000	1,305,000	2,068,400
	In USD	136.50	326.30	517.10

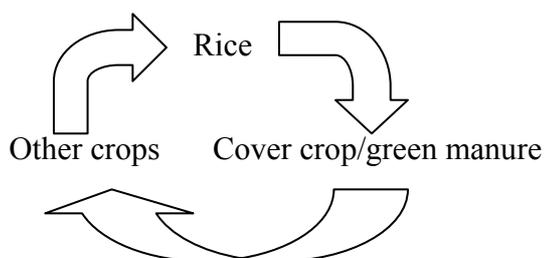
3.4. Experiences of fish raising and trapping in a Multi-Purpose Farms

With a pond and surrounding canals as part of their MPF, farmers are able to maintain an effective system of rice-fish culture that includes both *cultivated fish and natural fish*. Rice-fish culture is a system that can help farmers to make higher yields of both rice and fish. The fish are allowed to go and find feed in the rice field, and they eat worms, insects and grass seeds which are pests for rice. The fish also helps in improving oxygenation to the soil and deposit faeces that enrich the soil. In addition, when there is abundance of food sources for the fish, this helps the fish to grow very well.

This rice-fish system in MPF involves having a canal around rice field connected to the pond which is the main fish habitat. The fish can move freely into and out of the rice field through the canal. Farmers have often built a larger and higher dike around their farms in order to protect the fish in their farms. From fish raising, farmers can earn money up to 192,200 riels (about 48 USD), whereas previously, they would have gotten only 30,000 riels (7.5 US dollars) from this source. This calculation does not count the amount of home-consumption of fish with MPF which can be significant for family health.

3.5. Experiences of designing cropping system in Multi-Purpose Farms

The cropping system with MPF should be well-designed in terms of its basic plots, which include rice fields, upper-field land, and surrounding dikes. Farmers must apply crop rotation system on their rice fields in order to maintain soil fertility and to ensure high yields of rice for the next year. This usually means alternating rice in the main wet summer season with some vegetables or legumes grown in the dryer winter season. Ideally, there is also a green manure or cover crop inserted between the rice and other crops, as shown in the following diagram.



On upper field lands, farmers can grow many kinds of crops/plants with good selection in designing their cropping plan. Large fruit trees should be planted on the western side of the farm to avoid the impact of their shade on other crops when they become large.

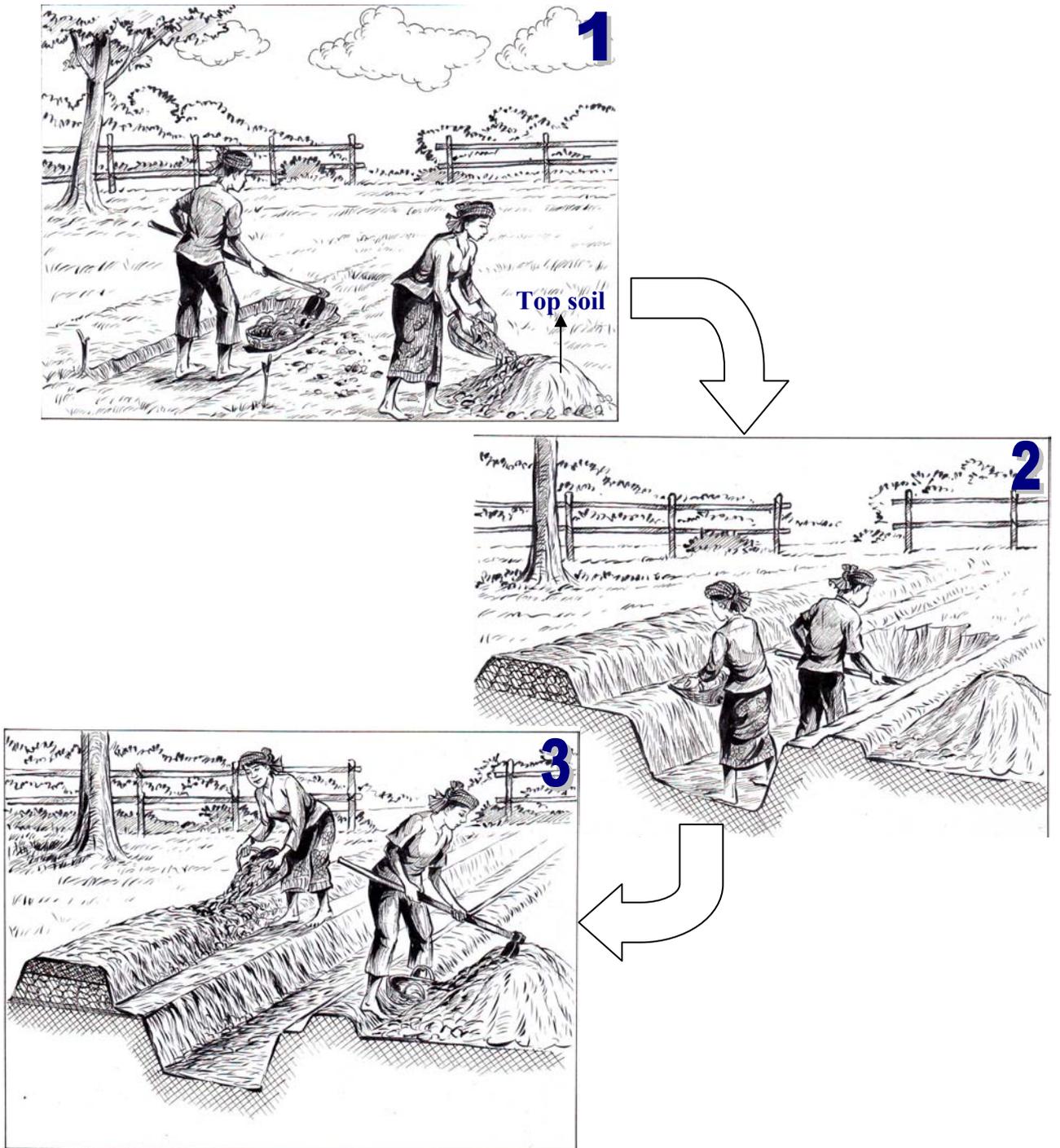
On the surrounding dike, farmers could plant multi-purpose trees (coppicable/pollardable) as a living fence. Good species include *Cassia siamea Papilionaceae*, *Sesbania grandiflora Papilionaceae* and *Leucaena leucacephala Leguminosae*. On the inner side of the dike, farmers can grow other crops such as cassava, sugar cane and corn.

The following are some kinds of crops/plants that are commonly being grown on upper field lands of MPF:

- Fruit trees: mangoes, jack fruit, coconuts...
- Perennial plants: papayas, bananas, pineapple, chillies...
- Vegetables: fruity, leafy and root vegetables.
- Spices: lemon grass, basil, mint, garlic and turmeric...

3.6. Experiences of soil quality management in Multi-Purpose Farms

Some farmers did not pay attention to managing soil quality at the outset, especially when they dug their ponds and canals. They put topsoil at the bottom of their dikes or upper fields land and then used clay soil (from deeper land) to build their dikes or upper fields. It is very difficult to grow any crops in the first year unless farmers have ensured the quality of their soil first. Therefore, farmers should be careful to manage their soil quality, especially on upper field land and dikes where they produce many crops. This involves thought and care in their initial land forming and on-going enrichment of their crop soil with organic matter.



Picture 17: A method to manage soil quality

V. SYNTHESIS OF GOOD EXPERIENCES

Briefly, developing a good MPF requires farmers to concretely apply many techniques and to carefully and purposefully practice their agriculture. The main ideas and techniques of MPF development are as follows:

- Initially, take small steps to convert part of the rice field into ponds, canals, upper field land, dikes and living fences, investing money, labor, time and materials as necessary to create a **more productive farming operation**.
- Plan the location and scale of each element of MPF, according to market opportunities, soil capabilities, and time and logistical considerations. This means that farmers should draw a map of what they want to achieved, thinking through the reasons for each decision, so they have a clear design and plan for their MPF development for **best use of all available resources**.
- Diversification of crops, animals and aquaculture production is the main process of MPF development. This should be well planned and implemented by farmers in order to increase the **productivity** of their MPF, especially making optimum use of available family labor.
- Management systems of MPF should be carefully organized by farmers in order to ensure the **sustainability** of their production such as soil quality management, water management, diversification of elements, living fences, and timing, harvesting, possibly processing, and sales of MPF products.
- Farmers should effectively apply **ecological agricultural techniques** such as the System of Rice Intensification (SRI), Ecological Chicken Raising (ECR), Fish Raising and Trapping, and Ecological Crop Growing, as well as other techniques such as frog raising, eel raising, earthworm raising, and fish raising in plastic containers, etc.
- For the **diversification** of crops, farmers should include perennial and semi-perennial trees/plants along with annual and seasonal crops. This is to ensure the production throughout the year because some perennial plants will produce products during the dry season when farmers face difficulties in growing annual and seasonal crops.

V. CONCLUSION

Briefly, we can assume that farmers will try to develop an effective MPF to diversify their production and increase the productivity of their small rice fields if these are about 0.65ha, although a number of the most successful MPF farmers have started with an area only two-thirds this size. Determined investment with clear planning can enable farmers' families to escape from their chronic food shortages, creating regular work and year-round income.

It has been gratifying to see that with MFP, it may become possible for farmers to pay their children a decent income for work on their household MPF enterprise. This gives them a reasonable alternative to migration to urban areas. This has been the experience of Roas Mao, showing how MFP is an on-going evolving process to improve the quality and security of rural Cambodian households.

Facing and resolving difficulties in the beginning of their MPF development can serve to improve farmers' family livelihoods subsequently.