

Impacts of CFC-FAO-ICRISAT Livelihood Improvement Project in Asia

Region II - Thailand



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Impacts of CFC/FAO/ICRISAT Livelihood Improvement project in Asia

Region II Thailand

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A Report on
Impact Assessment Survey

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Global Theme on Crop Improvement



**International Crops Research Institute
for the Semi-Arid Tropics**

Patancheru – 502 324, Andhra Pradesh, India

2009

Foreword

This is a report on the impact assessment survey, which was done as part of the CFC/FAO/ICRISAT project entitled *Enhanced Utilization of Sorghum and Pearl Millet Grains in Poultry Feed Industry to Improve Livelihoods of Small-scale Farmers in Asia*. The project was implemented from May 2005 to March 2009 in the sorghum growing area of Thailand, both in white sorghum planting area (Suphan Buri and Kanchanaburi) and the red sorghum planting area (Nakhon Sawan and Lopburi).

A detailed final survey was conducted through questionnaires. All information contained herein is based on the interviews and questionnaires, and therefore reflects the views of the respondents. The respondents who participated in the project were interviewed and the cost of sorghum production was recorded. Respondents outside the project area were similarly interviewed for comparison.

We would like to thank and acknowledge the CFC (Common Funds for Commodities) for supporting the project, FAO for project advisory and ICRISAT for project executing agency.

FCRI, Bangkok

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Chapter I: Cluster-level indicators for white and red sorghum

Country/State/Province: **Thailand**
 Cluster of: **6 villages in 3 provinces**
 Target crop: **Sorghum**

1. No. of Villages/ Farmers:

Year	Total no. of villages		Total	No. of farmers involved in the project		Total
	Existing	New villages		Existing	New farmer	
2005	-	6	6	-	289	289
2006	6	2	8	289	152	441
2007	8	-	8	441	65	506

The project began with 6 villages in three provinces—Suphan Buri, Kanchanaburi, and Nakhon Sawan, in 2005. The names of the villages are Jorake Sampan, Laokwan, Takfa, Lampayon, Punak, and Suksamran. In 2006, the project area was extended to include two villages, Nongmuang and Koksamrong, in the Lopburi province. The project, which started with 289 farmers in 2005, ended in 2007 with 506 farmers in 8 villages.

2. Area production, yield of sorghum

Year	Area (in ha)	Production (in ton)	Yield (in ton/ha)
2005	1,580	2,875	1.82
2006	2,200	3,938	1.79 *
2007	2,530	4,756	1.88

* This was a drought year

3. Marketed surplus of sorghum grain

Year	Total production (in tons)	Marketed Quantities (in tons)	Average price or range	
			Market price (in baht/kg) ¹	Price obtained by the target farmers (in baht/kg) ¹
2005	2,875	2,870*	4.5-5.5	4.5-5.5
2006	3,938	3,933**	5.1-6.2	5.1-6.2
2007	4,756	4,750***	6.3-7.5	6.3-7.5

1. 1 US\$= 33 baht

* 5 ton for seed, ** 5 ton for seed, *** 6 ton for seed

4. Training programs conducted in 2005-2007

Year	Title of Training program (with serial number by year)	Total no. of participants	
		Male	Female
2005	<u>On station training</u>	45	40
	1 Red Sorghum Production I	51	32
	2. Red Sorghum Production II	39	22
	3. White Sorghum Production and Cattle's Raising		
	<u>Mobile training1.</u>	53	40
	Agricultural Fair, National corn and sorghum research center (Suwan farm), Nakhon Raschasima		
2006	<u>On station training</u>	37	21
	1.Red Sorghum Yield Improvement	35	23
	2.White Sorghum Yield Improvement		
	<u>Mobile training</u>	22	20
	1. Agricultural Fair, (Suwan farm), Nakhon Raschasima	22	25
	2. Agricultural Fair, Kasetsart University, Nakorn Pathom I		
	3. Agricultural Fair, Kasetsart University, Nakorn Pathom II		
	4. Agricultural Fair, Kasetsart University, Nakorn Pathom III		
	<u>In place training</u>	15	20
		23	22
	1. Fumigation		
	2. Seed germination test	15	-
	<u>Field day</u>	18	22
1.Demon. Fields & others	7	-	
<u>Exposure visits</u>			
1.Duck farms & mushroom farms			
2007	<u>On station training</u>	60	55
	1. Nature of Soil & Fertilizer I	36	34
	2. Nature of Soil & Fertilizer II		
	<u>In place training</u>	8	-
	1. Fumigation	3	14
	2. Seed Production		
	<u>Field day</u>	31	19
	1.Demon. Fields & others		
	<u>Exposure visits</u>	3	15
	1.Duck farms & mushroom farms I	8	12
	1.Duck farms & mushroom farms II	12	15
	1.Duck farms & mushroom farms III		

5. Training material developed and distributed: 2005-07

Year	Type of material (flyer/ poster/literature)	Title of the Material	Nos. distributed ¹
2005	Copied paper	Red sorghum production Red sorghum	200
	Flyer	cultivar : Pac 88	200
	Flyer	Red sorghum : FBC 111	200
	Flyer	Red sorghum : FBC 999	200
	Leaflet	White sorghum production Cattle's	200
	Copied paper	raising	200
	Leaflet	Seed Germination Test	200
2006	Booklet	Red sorghum production	1,000
	Booklet	White sorghum production	1,000
	Poster	White sorghum cultivar: UT 1694	2
	Poster	White sorghum cultivar: UT 1658	2
	Poster	White sorghum cultivar: KU 439	3
	Poster	White sorghum cultivar: RMW 1	2
	Poster	White sorghum cultivar: Late Hegari	2
	Poster	White sorghum cultivar: Early Hegari	2
	Poster	Row Planting	2
	Poster	Fumigation	2
	Poster	Seed Germination Test	2
	Poster	Soil Sampling and Soil Analysis	2,2
	Poster-board	Sorghum in India	1
	Poster-board	Sorghum in China	1
	Booklet	Household account/ BAAC	200
	Booklet	About credit/BAAC	200
	Flyer	How to avoid fake chemical fertilizer	500
	Flyer	Red sorghum cultivar : Pac 88	200
	Flyer	Red sorghum: FBC 111	200
	Flyer	Red sorghum: FBC 999	200
2007	Booklet	Nature of Soil and Fertilizer	1,000
	Booklet	White Sorghum Seed Production	1,000
	Leaflet	Soil Sampling & Soil Analysis	5,000

1. All training material was in thai.

6. On-farm demonstration 2005-2007

Year	Type of demonstration	Results	No. of farmers participated	Impact achieved
2005	-			
2006	1. Improved cultivars 2. Planting methods : Row & Broadcast 3. Fertilizer application	Yield from demon. fields was 15-20% higher than local practices.	250-300	Improved cultivars with row planting showed good yield in white sorghum.
2007	1. Improved cultivars 2. Planting methods : Row & Broadcast 3. Fertilizer application	Yield from demon. fields was 20-30% higher than local practices.	400-500	Demon. fields were very attractive with big placard, good yield and in big area (2-10 ha)

In 2006 Suphan Buri and Kanchanaburi 11 field demonstrations Nakhon Sawan and Lopburi 12 field demonstrations

In 2007 Suphan Buri and Kanchanaburi 4 field demonstrations Nakhon Sawan and Lopburi 4 field demonstrations

7. Soil samples tested and their results

Year	No. of samples /Plots	Tested on parameters	Test Results Conclusions
2005	-	-	-
2006	23	pH, EC, total N, % OM, Avail. P and Exch. K	N deficiency
2007	40	pH, EC, total N, % OM, Avail. P and Exch. K	N deficiency

Soil analysis results from white sorghum planting area showed soils low in nitrogen and organic matter. Therefore nitrogen fertilizer such as Urea (46-0-0) or Ammonium Sulfate (21-0-0) were recommended to farmers at the rate of 75kg N/ha.

In the red sorghum planting area, soil fertility is good as chicken manure was applied as was chemical fertilizer (16-20-0) for the first crop (corn). However, nitrogen fertilizer such as Urea (46-0-0) or Ammonium Sulfate (21-0-0) were recommended to farmers at the rate of 75kg N/ha in order to maximize yields from sorghum.

8. Grain Samples tested and Results obtained

Year	No. of grain samples tested	Tested on parameters	Test Results/Conclusions
2005	55	Aflatoxin and Fumonisin	9 out of 55 samples had Aflatoxin >20 ppb 4 out of 55 samples had Aflatoxin >50 ppb 0 out of 55 samples had Fumonisin >1 ppm
2006	92	Aflatoxin and Fumonisin	3 out of 92 samples had Aflatoxin >20 ppb 1 out of 92 samples had Aflatoxin >50 ppb 0 out of 92 samples had Fumonisin >1 ppm
2007	20	Aflatoxin and Fumonisin	out of 20 samples had Aflatoxin >20 ppb out of 20 samples had Aflatoxin >50 ppb out of 20 samples had Fumonisin >1 ppm

In 2005, aflatoxin was found in 9 sorghum samples which registered readings of over 20 ppb. This is probably due to the fact that the rainfall continued till extended until November.

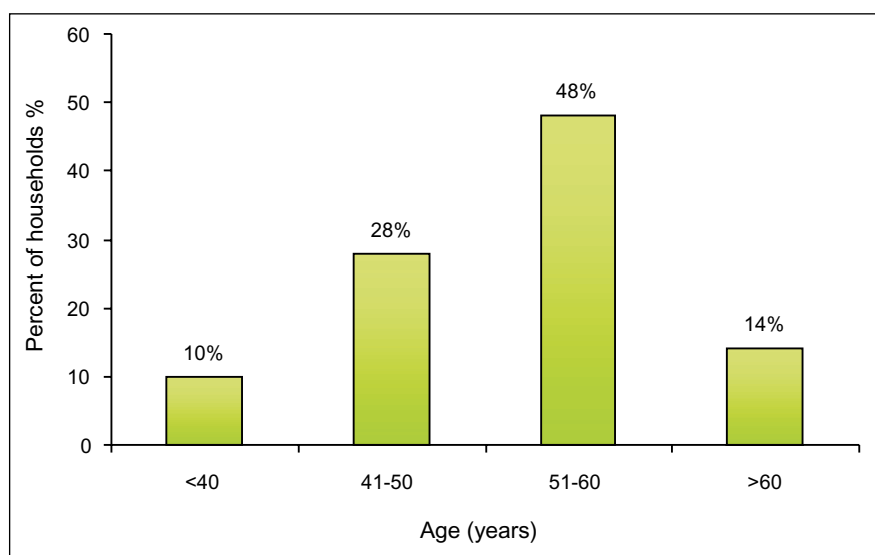
In 2006, the rains were over stopped by mid-October. Therefore, very few sorghum samples had aflatoxin over the regulation limit.

Overall the sorghum grain quality was good in Thailand. Generally sorghum is planted in drought prone area and harvested in dry season. Therefore, most samples passed the regulation limit (20 ppb or 50 ppb in some countries). In Thailand, the regulation limit is 20 ppb for feed. So all feed mills now check for aflatoxin and Fumonisin B1 in the feed and not in the raw materials.

Chapter II: Impact Assessment Survey (white sorghum)¹

General information

The final survey was carried out between January and February 2008. respondents twenty nine farmers for white grain sorghum planting areas in Suphan Buri and Kanchanaburi were interviewed. Of these 18 were males (62%) and 11 females (38%). The age of the household head ranged between 29-68 years, with an average of 48 years. 48% of the households were 51-60 years is 48%, between 41-50 years is 28%. The distribution of age range is shown graph 1.



Graph 1. Distribution of age range of household head in years

The average years of schooling of household head was 5.5 years. The literacy rate of the project respondents is 92%, while 8% did not attend school at all. In the past 30 years, compulsory schooling was only 4 years and they could read and write. At present, the compulsory schooling is 12 years.

The main primary occupation of the household head is crop farming, with 89.7% of the respondents stating this as their primary occupation. This category includes agricultural labor and cow rearing. Other types of primary occupations were salaried worker (3.4%) and retailer or shop owners (6.9%). The main subsidiary occupation is agricultural labor (86.2%)

¹ A sample of project farmers randomly selected for the impact assesment survey.

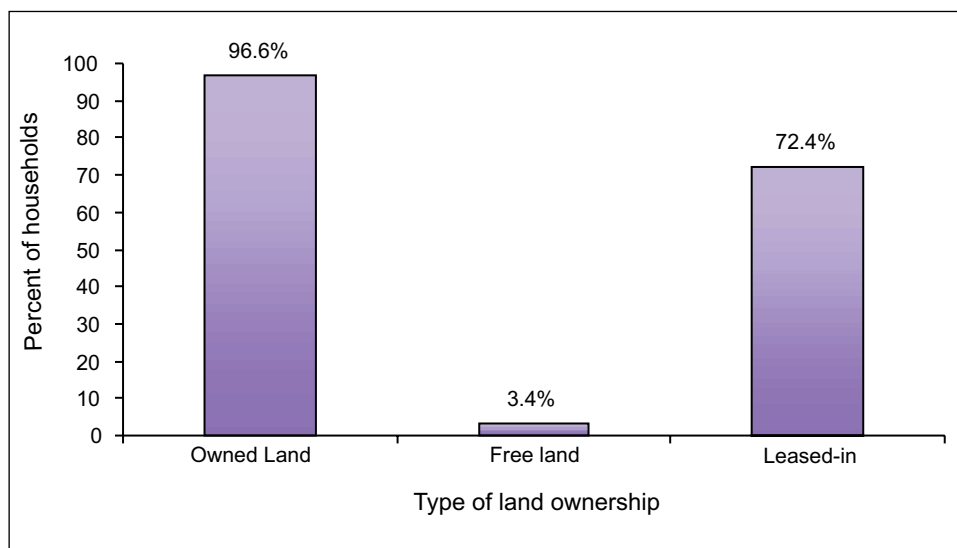
The family size among the respondents ranges between 2-8 people, with an average size of 4.65. Average number of labor in the family is 3.24 people (69.9%). The average number of dependents between 3-17 years in the household is 1.41 persons (30.4%), and an average of 1.14 school going children.

Seventy nine percent of the respondents in 2008 who participated in the impact assesment survey, were part of the baseline survey carried out in 2005.

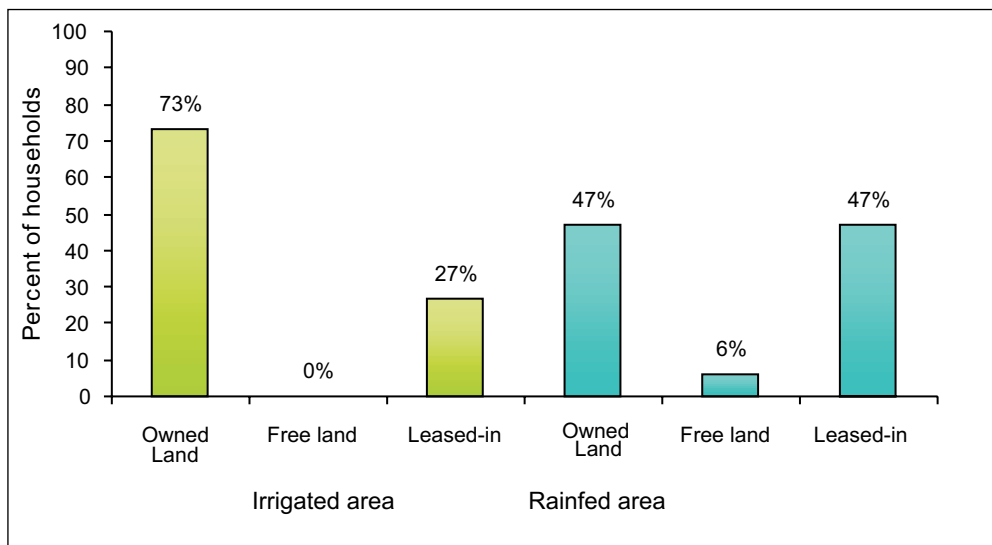
Current Land Inventory

Most of the households (96.6%) owned the land the worked on and a significant number (72.4%) leased in more land. Only 1 of 29 respondents had his own land and got free land (graph 2). The rent of the land is between 1,875-3,125 baht/hectare with the average of 2,187 baht/ hectare. The land is 93.5% rainfed area and 6.5% is irrigated area. Some land of project farmers in Suphanburi is irrigated area where paddy is planted. But in Kanchanaburi, all of the land is rainfed. In the irrigated area, 73% of the total land area is owned by farmers and 27% is leased. In rainfed area, 47% of the total area is owned land, 47% is leased in and 6% is free land (graph 3).

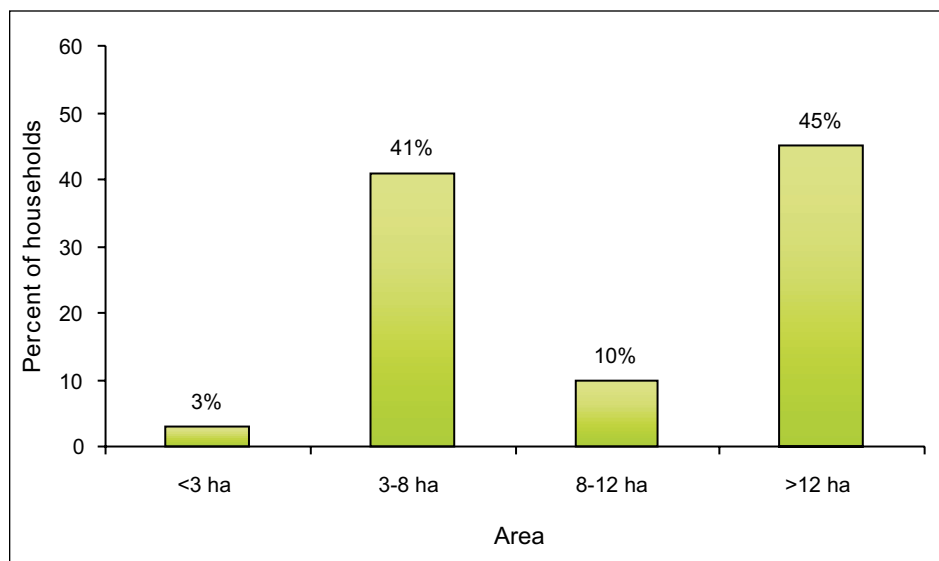
Distribution of household area in hectares is shown in graph 4. Most of project farmers have more than 12 ha (45%). The average household area is 11.21 ha.



Graph 2. Current household land inventory (in percent), 2007.



Graph 3. Current land inventory for irrigated and rainfed areas (in percent), 2007.

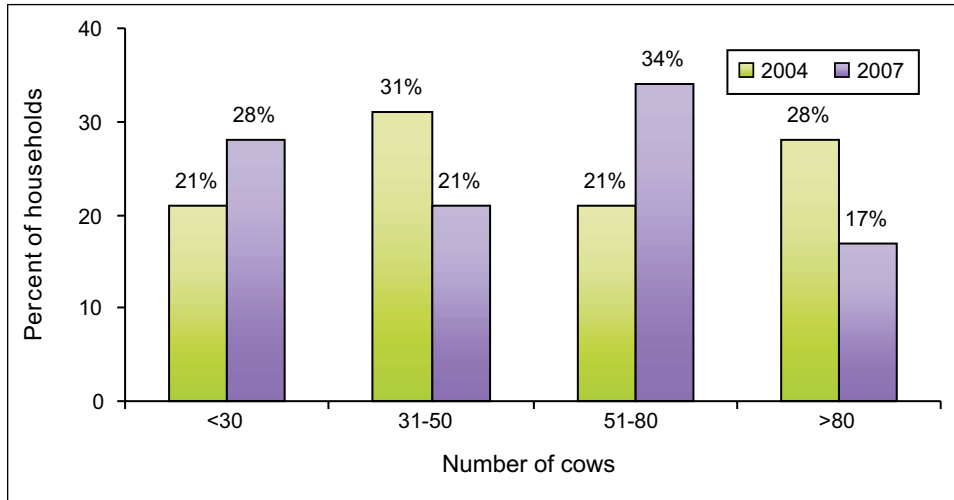


Graph 4. Household landholding in hectares.

Livestock

Among the respondents, 89.6 percent raise beef cows. Number of the household livestock (beef cows) in 2004 was 28% less than 30 cows, 21% of the household livestock has 31-50 cows, 34% has 51-80 cows and 21% has more than 80 cows (graph 5). The average household livestock in 2004 was 49 cows. But in 2007, the average household livestock was 56 cows.

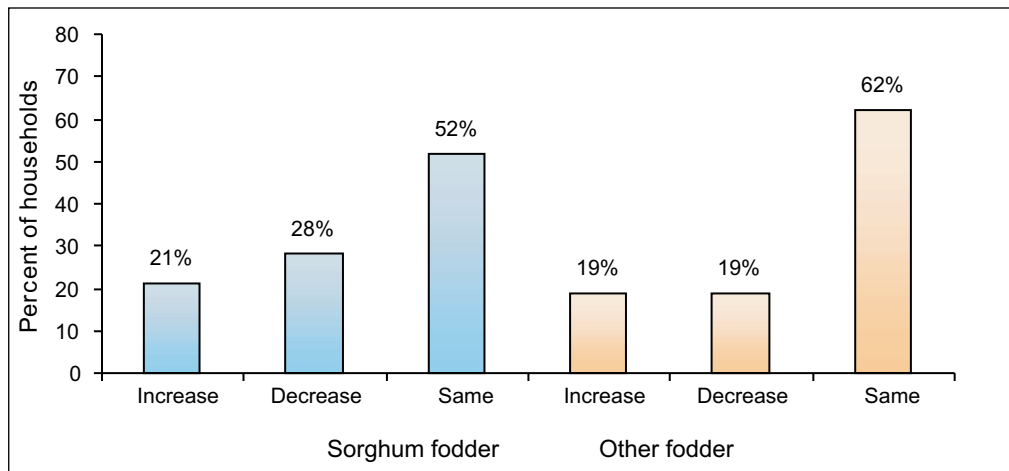
In comparison, number of the household livestock in 2004 and 2007 were not very different. There were some changes in household distribution, with some households selling their livestock and others increasing livestock numbers due to the birth of calves.



Graph 5. Household livestock numbers (beef cows) in 2004 and 2007.

Fodder resources

There was very little change in the fodder resources between 2004 and 2007. The fodder resource is 52% from sorghum stalk and 62% from other fodders (paddy straws, corn stalks, cassava and other grasses) which remained the same between 2004 and 2007 (graph 6).

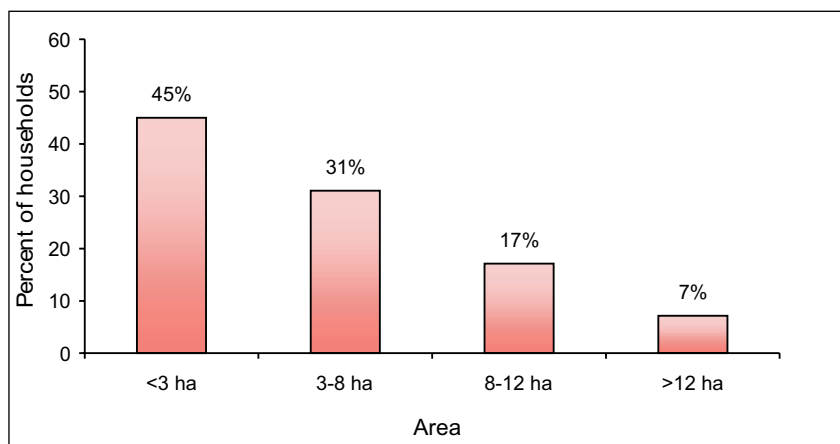


Graph 6. Change in percentage of fodder resources per household between 2004 and 2007.

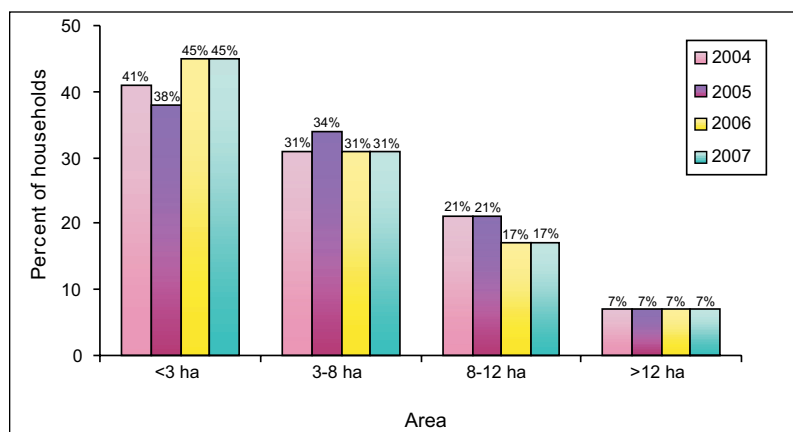
Cropping pattern in 2007 and area under sorghum

Generally, white sorghum is planted in early in the rainy season. However in 2007, the onset of rains was delayed as a result of which 94% of the sorghum was planted in the late rainy season in August-September. Only 6% was planted in the early rainy season.

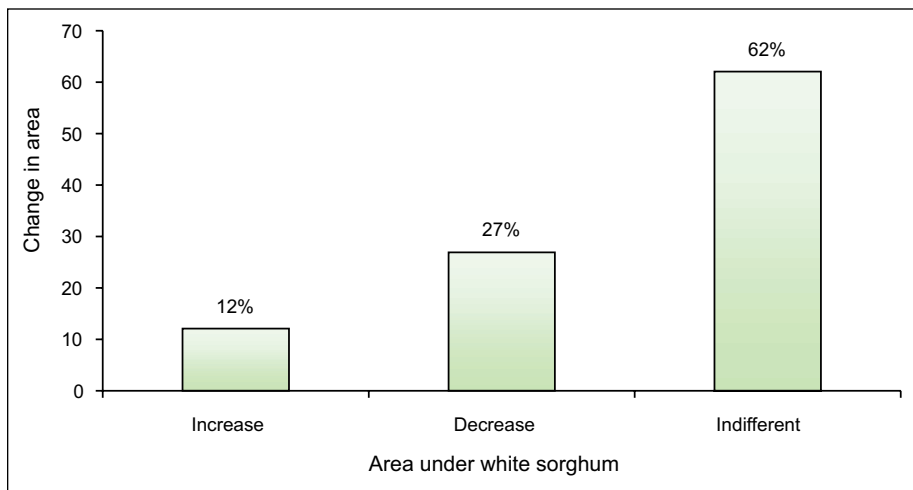
45% of the white grain sorghum is planted on farms with less than 3 hectares of land and a further 31% on landholdings between 3 and 8 hectares (graph 7). There has been no shift in this pattern from the baseline over the project years (graph 8). In 2006 and 2007 there have some marginal increases in the land under white sorghum in the small and medium categories (graph 8). There was no change in 62% of the area under white sorghum while it decreased in 27% and increased in 12% of the area (graph 9).



Graph 7. Percentage of farm size of white grain sorghum in 2007.



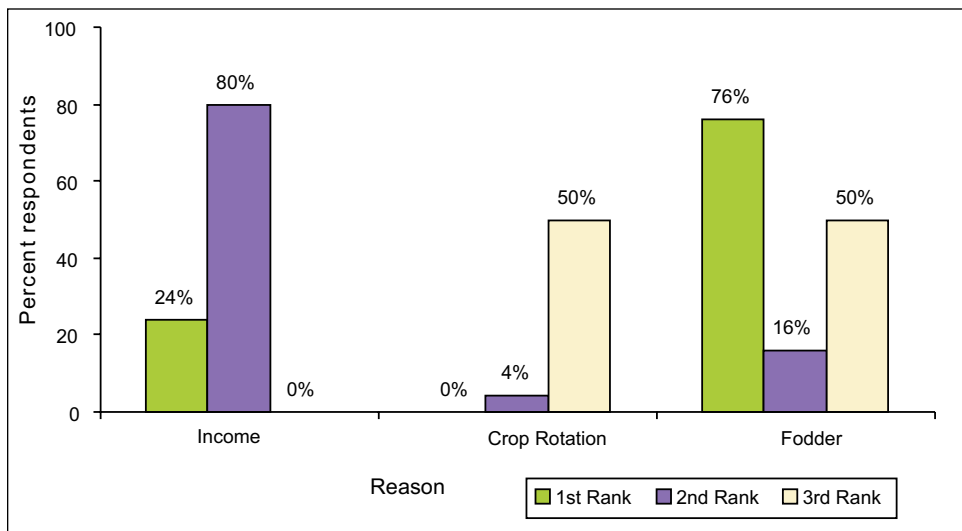
Graph 8. Farm size under white sorghum in 2004-2007.



Graph 9. Change in area under sorghum between 2004 and 2007.

Reasons for growing white sorghum

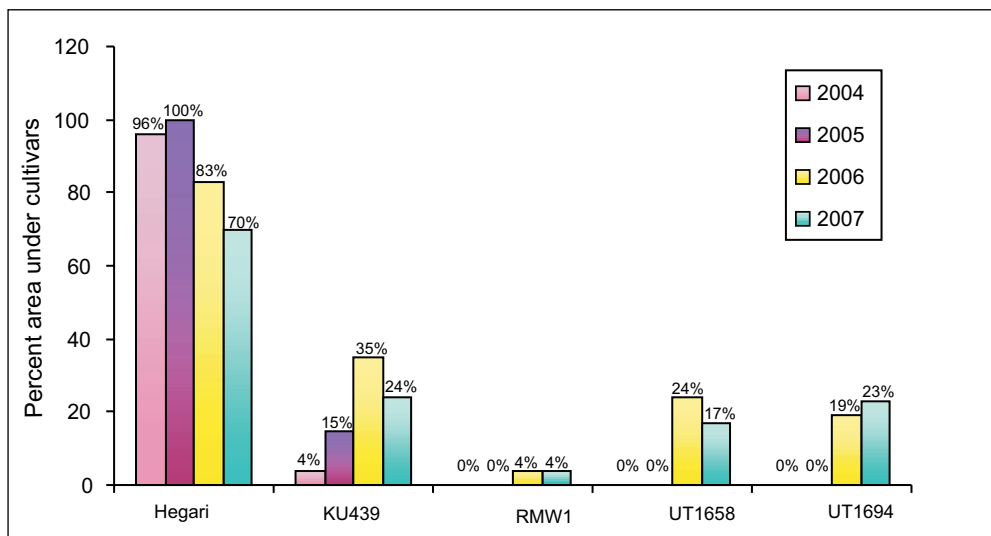
The main reason for growing white sorghum are for fodder with 76% of the respondents stating this as their primary motivation. 24% of the respondents ranked income as the primary reason for growing sorghum. 80% ranked income second, 16% fodder and 4% crop rotation (graph. 10).



Graph 10. Reasons for growing white sorghum.

Cultivars of sorghum used from 2004-2007

Traditionally, the most popular cultivar of white sorghum is Hegari. Under the project, the new cultivars were introduced to project farmers in 2006, i.e. UT 1658, UT 1694, KU 439 and RMW 1 (graph. 11). As the graph shows, these cultivars have been increasing in popularity, particularly KU439 and UT1694.

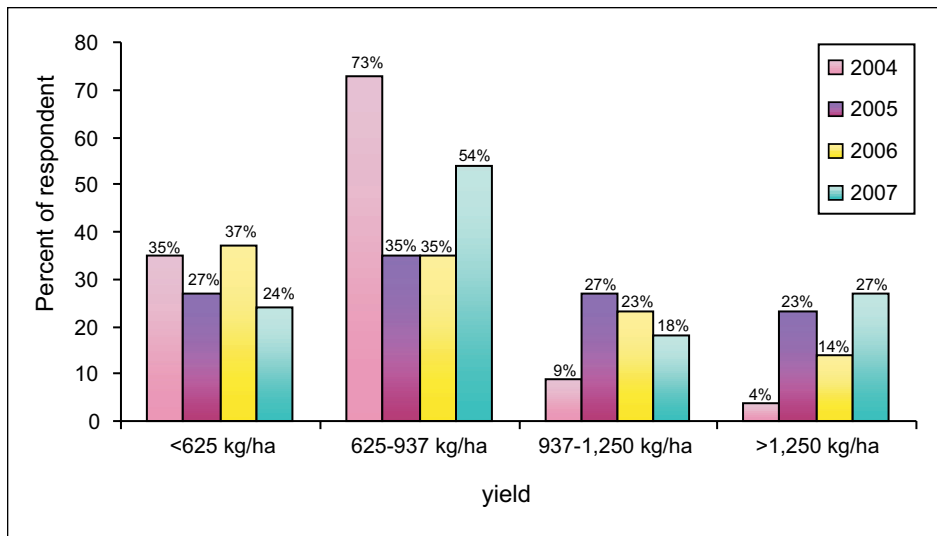


Graph 11. Percent area under different cultivars of white sorghum, 2004-2007.

Yields and harvest price information in 2007

Sorghum yields in the project area were very low at the start of the project as it was grown on inferior soils in rainfed conditions. The soil surface area shallow and soil moisture is lost easily. As sorghum is primarily grown for fodder, some sorghum fields were not even harvested but were used for grazing. The average yield levels have been increasing since the start of the project and in 2007 white sorghum yields averaged 1.2 ton/ha compared to 0.9 ton/ha in 2004

In 2007, the average harvest price was 6.56 baht/kg which ranged between 6.25-7.0 baht/kg¹.



Graph 12. Distribution of grain yield of white sorghum (kg/ha) in 2004-2007.

Product Utilization

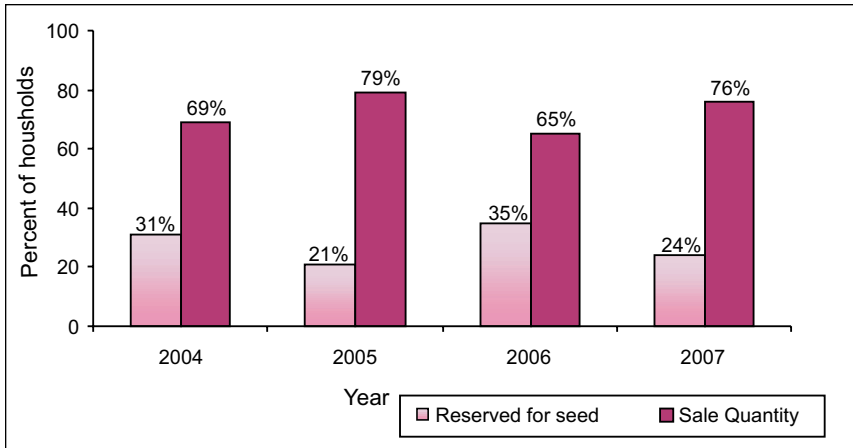
Generally, sorghum grain is sold and a relative small portion is kept as seed for the next planting. In 2007, 76% of produced sorghum is sold and 24% is stored for seed (graph 13). Since sorghum is grown in rainfed conditions, the quantity reserved for seed is large in order to accommodate more broadcasting during drought years.

The sale price in 2004, 2005, 2006 and 2007 were 4.44, 4.93, 5.65 and 6.56 baht/kg respectively (graph 14). Sorghum prices have been increasing every year in tandem with corn prices. Sorghum is a cheaper substitute to corn, and sorghum prices are usually 15-20% lower than corn prices.

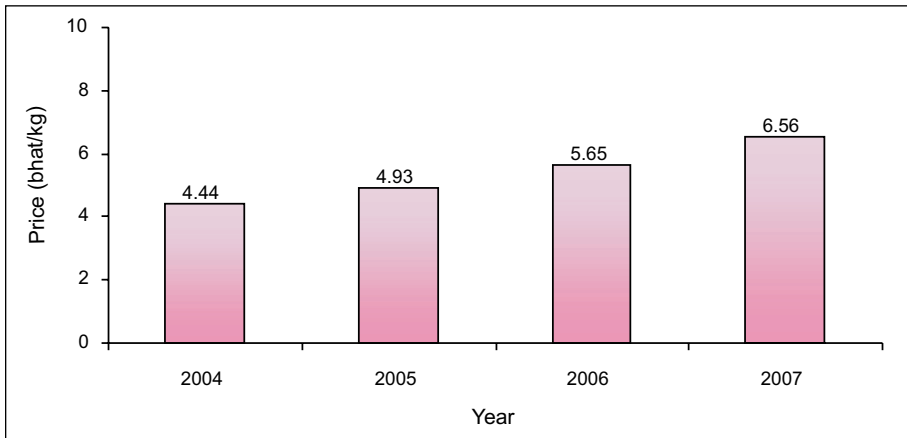
In November-January, sorghum is harvested and threshed. Then it is transported to the local middleman in U-thong. Most of the sorghum is sold immediately after threshing. White sorghum is sold mostly in December (graph 15). Very little sorghum is sold in September (Early rainy planting).

In 2004, the percentage of respondent who stated their seed sources from own save seed, seed shops and FCRC were 55, 22 and 22% respectively. In 2007, 67% of respondents got sorghum seed from the project (graph 16).

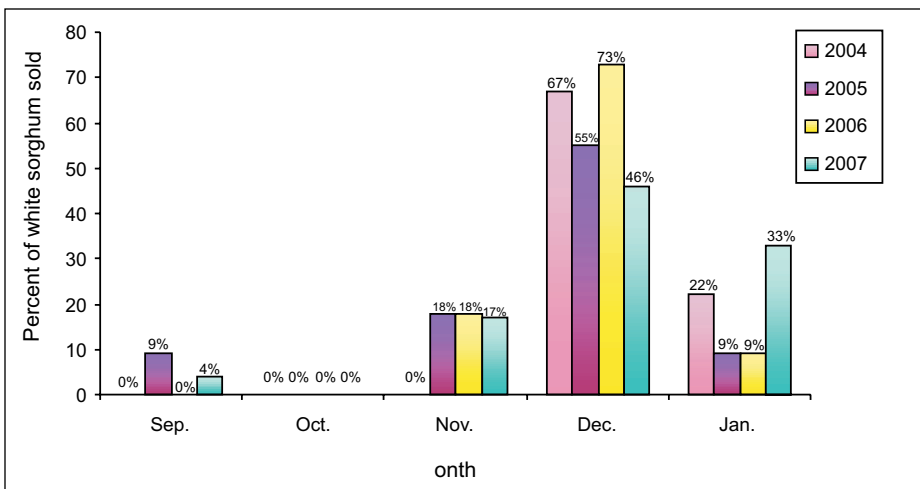
¹ US\$= 33 baht.



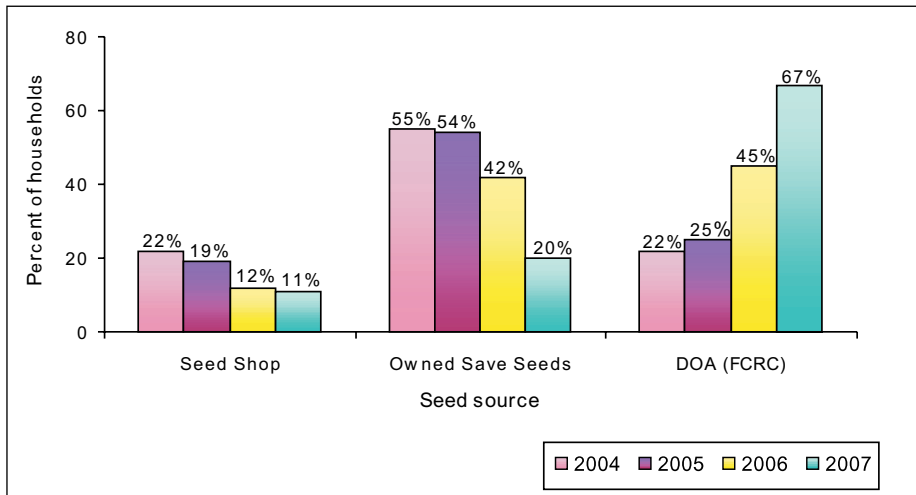
Graph 13. Grain sorghum utilization in 2004-2007.



Graph 14. Average sale price (baht /kg.) of white grain sorghum in 2004-2007.



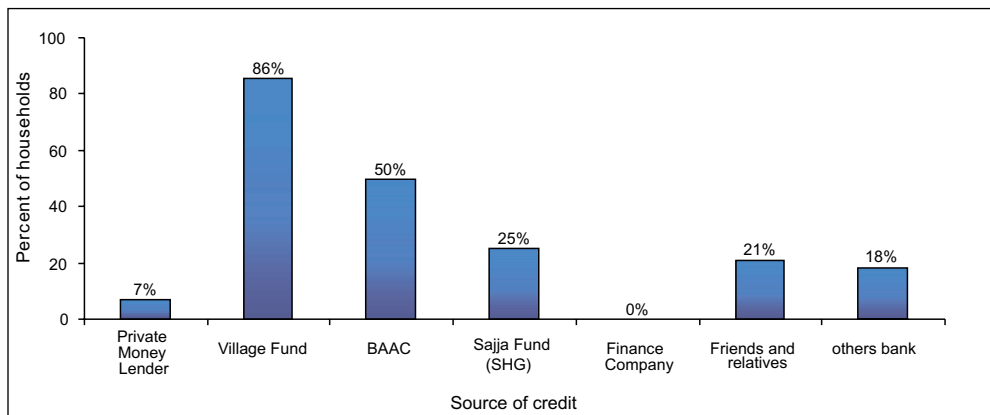
Graph 15. Month-wise sale of white grain sorghum.



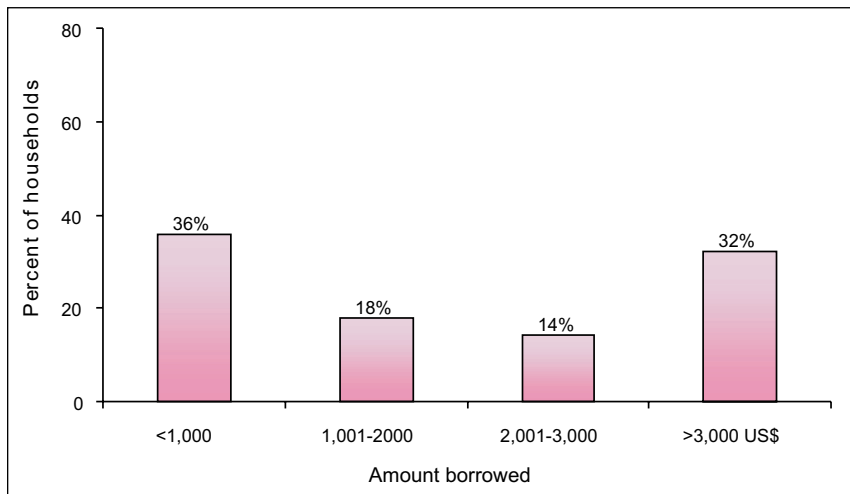
Graph 16. Household seed sources (in percent).

Current sources of agricultural credit

The most popular agricultural credit is from the Village Fund where the interest rate is 6% per year, followed by Bank for Agriculture and Agricultural Cooperatives (BAAC), Sajja fund, friend & relatives respectively (graph 17). Only one out of the 29 respondents had no debt (1 out of 29 respondents). The interest rate of BAAC is 6-8% per year depending on the credit grade of clients such as AAA client get 6%, new client has got 12%. Total amount borrowed is between 10,000-490,000 baht with an average of 38,553 baht (1,168 US\$). The percentage of respondent who borrowed money less than 1,000 USD is 35.7%, between 1,001 and 2,000 USD is 17.8% (graph 18). 64% of respondents have more than 1 credit sources, such as from both Village Fund and BAAC.



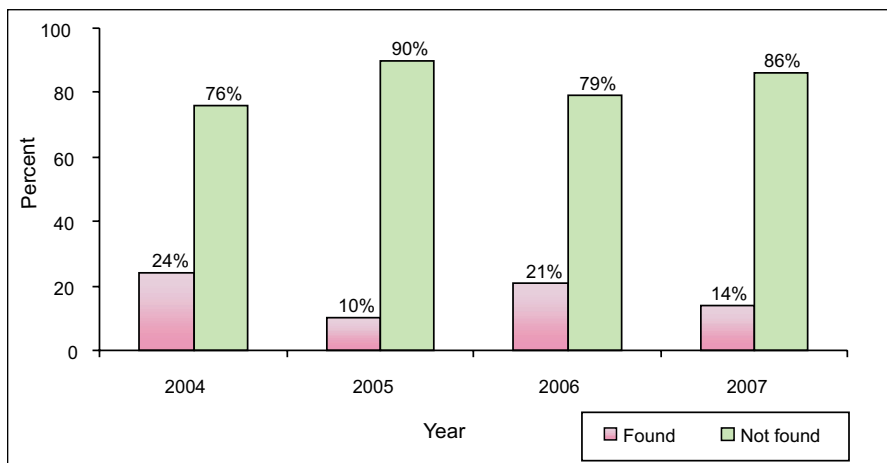
Graph 17. Sources of agricultural credit (percent households).



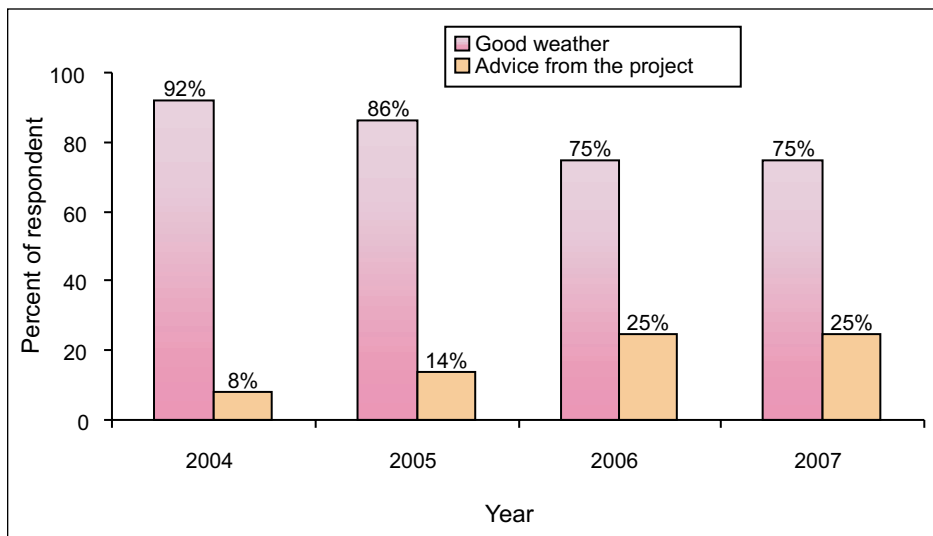
Graph 18. Distribution of amount borrowed per household (in US\$).

Grain mold

Typically for sorghum that planted in the late rainy season, grain mold is not a problem as the harvest season is in the dry months of November to January. However, for early rainy season planting where sorghum is harvested in September, grain mold is a normal occurrence. The incidence of grain mold has been varying considerably in the years 2004-07. The respondents credit weather conditions for the incidence of grain mold. They also credit the technical knowledge on storing and harvesting that was imparted as part of the project with the lower incidences of grain mold. In 2007, the incidence was down to 14% as opposed to the baseline incidence of 24% (graph 19 and 20).



Graph 19. Percentage of grain mold affected in 2004-2007.



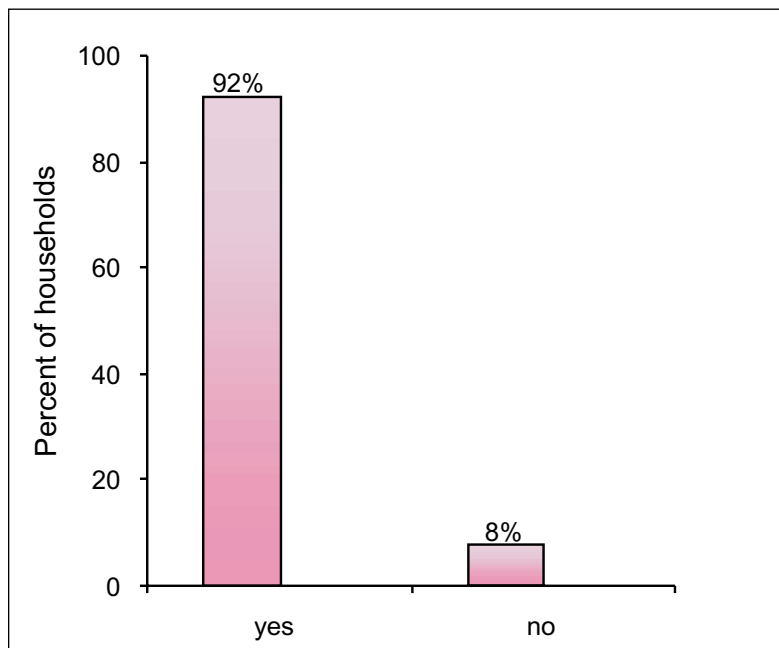
Graph 20. Reasons for lower grain mold incidence.

Market Intelligence

Sorghum is transported from the villages where it is grown and sold in nearby urban centers. Before the project, it was sold individually because the sorghum fields are far from each other and the harvest times are different. Bulk marketing was difficult to manage as sorghum is transported soon after threshing in the field. In addition to this, the traditional marketing system of farmers selling to the middle men in the urban centers was well-established with the middle men who had storage structures of their own. As a consequence of this, only 50 percent of the respondents said that bulk marketing was better than individual marketing. In the project area, there are 3 local middle men shops with godowns. The most popular market is called Ma Khao (White Horse shop), which is 2-10 km from the sorghum fields in Suphan Buri and 30 km from the sorghum fields in Kachanaburi. The other local middle men shops are also in U-Thong, which are very near Jorakhe sampan village (2-3 km). 69% of the respondents sold sorghum to the Ma Khao shop in U-Thong since they got the best price for their produce here.

92 percent of the respondents obtained information on market prices prior to the sale of sorghum (graph 21). The most popular channel was from family and friends with 85% of the respondents stating this as their primary source. Only 15 percent stated that they received their information from other sources such as FCRC and the market. However, a significant majority (87 percent) agreed that this information influenced their decision about whom to sell their produce to.

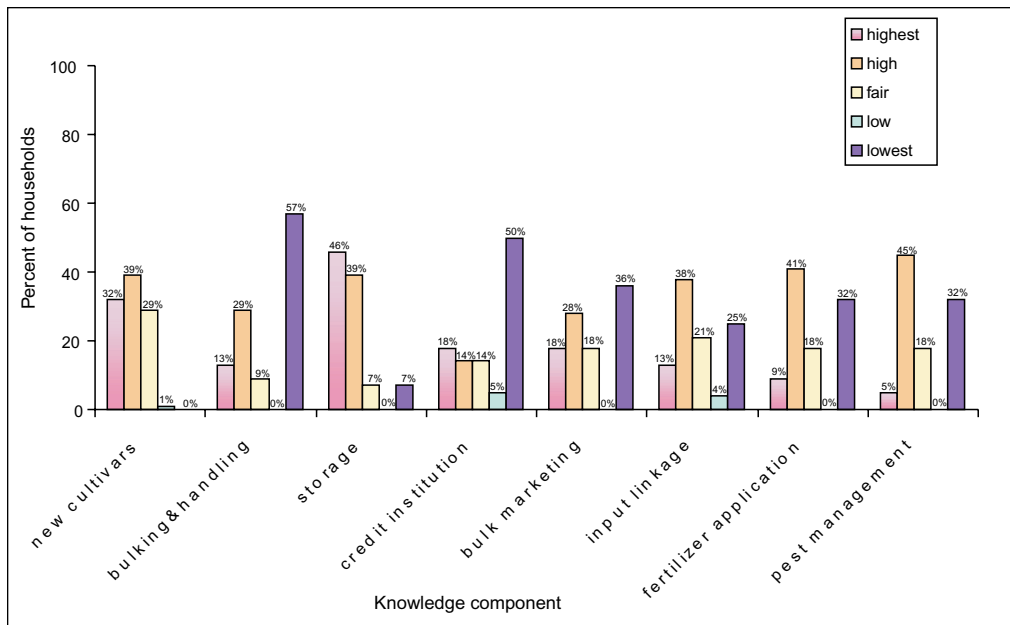
Owing to the fact that the component on bulk marketing was not carried out in Thailand, there are relatively low perceptions on the benefits of bulk marketing. It is interesting to note however, that half of the respondents said that they would be able to get higher prices for bulked products as opposed to individual sales.



Graph 21. Percentage of households that obtained information on market price.

Information on knowledge acquired through project

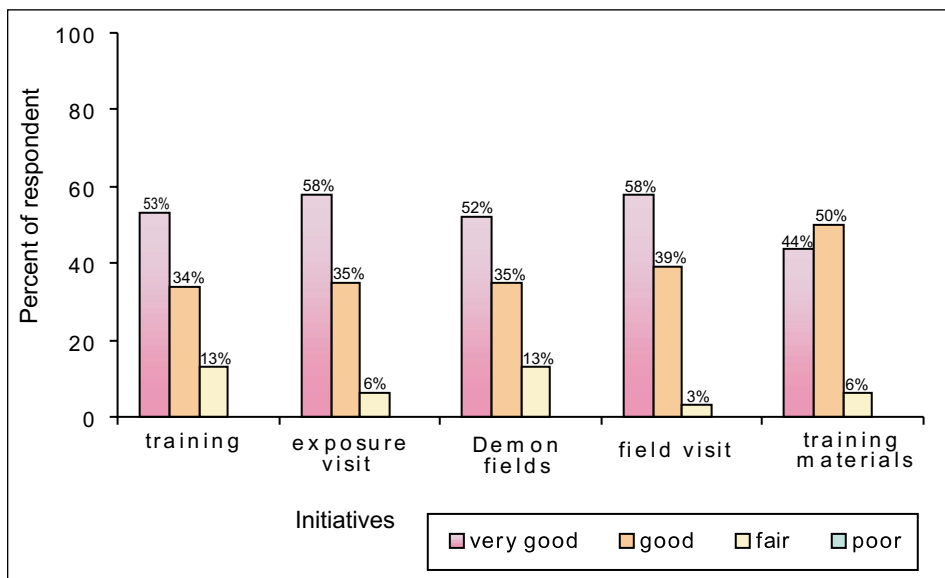
Overall the respondents were satisfied with the quality and depth of information that was disseminated in the project. They ranked the information on storage practices and new cultivars the highest. However, the information on bulking and handling, and credit channels were ranked the lowest. This low ranking is possibly due to the fact that the bulking and handling activity were not given a high priority in Thailand. Additionally, as has already been noted, there was a very high degree of awareness of the different credit channels that were available to them. Consequently, there was relatively less importance placed on disseminating information related to credit channels and to fostering linkages among farmers and credit institutions as in other project locations.



Graph 22. Ranking of knowledge acquired on different components of the project.

Training initiatives

The respondents were very satisfied with all activities such as training, exposure visits, field demonstrations, field visits and the quality of the training materials undertaken as part of the project (graph 23).



Graph 23. Household ranking of various initiatives under the project.

Input-Output Information

Crop:	White grain sorghum
Province:	Suphan Buri and Kanchanaburi.
Year:	2007
No. of respondent:	29 (18 males and 11 females)
Total area:	163.5 hectare
Total yield:	195,000 kg or space1.19 ton/hectare

Activity-wise break up of costs of production:

Cost heads	Material cost (baht/ha)	Labor (baht/ha)	Others (baht/ha)	Total cost (baht/ha)	Total cost (US\$/ha)¹
Land preparation	1,562.5			1,562.5	47.35
Sowing	364.4	71.6		436	13.21
Harvesting		899.63		899.63	27.26
Threshing	481.13			481.13	14.58
Total	2,408.03	971.23		3,379.26	102.40

1. 1 US\$= 33 baht

Benefit and cost analysis²:

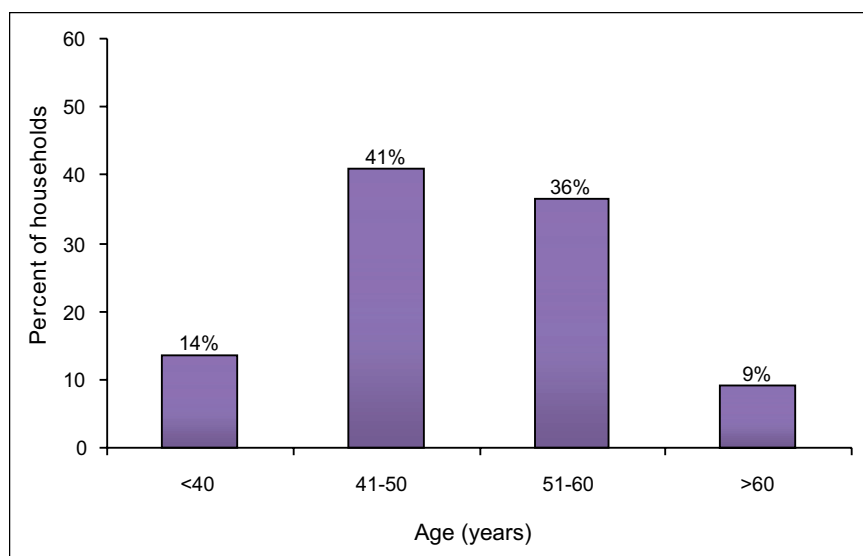
Variable	Project Sample (2007)
Cost of cultivation (baht/ha)	3,379.26
Grain yield (ton/ha)	1.19
Fodder yield (ton/ha)	16.25
Prices obtained for grains (baht/Kg)	6.56
Prices obtained for fodder (baht/ton)	100
Returns from grains (baht/ha)	7,806.4
Returns from fodder (baht/ha)	1,625
Gross returns (baht/ha)	9,431.4
Net returns (baht/ha)	6,052.14
B:C Ratio	1.79

² To refer to costs and profit calculation in terms of rai, (local thailand unit) refer to Appendix 1

Chapter III: Impact Assessment Survey (Red sorghum)³

General information

The final survey was carried out between January and February 2008. There were a total of 22 farmers who were surveyed in Nakhon Sawan and Lopburi, 16 of whom were males and 6 females. The average age of the respondents was 50.4 years, while the youngest respondent was 33 and oldest 75 years. 41 percent of the respondents could be classed in the 41-50 years bracket with the next highest bracket being 51-60 (graph 1).



Graph 1. Percentage of age of household head in years.

All the respondents were literate with 6 years of schooling on average. However, 54 percent of household heads have only 4 years of schooling, which were the mandated years of schooling to be considered literate in Thailand.

The main occupation of the respondents is crop farming (100%). 72.7% of the household heads listed agricultural labor as their subsidiary occupation. Only few have subsidiary occupations which are construction labor (9.1%) and other business (9.1%).

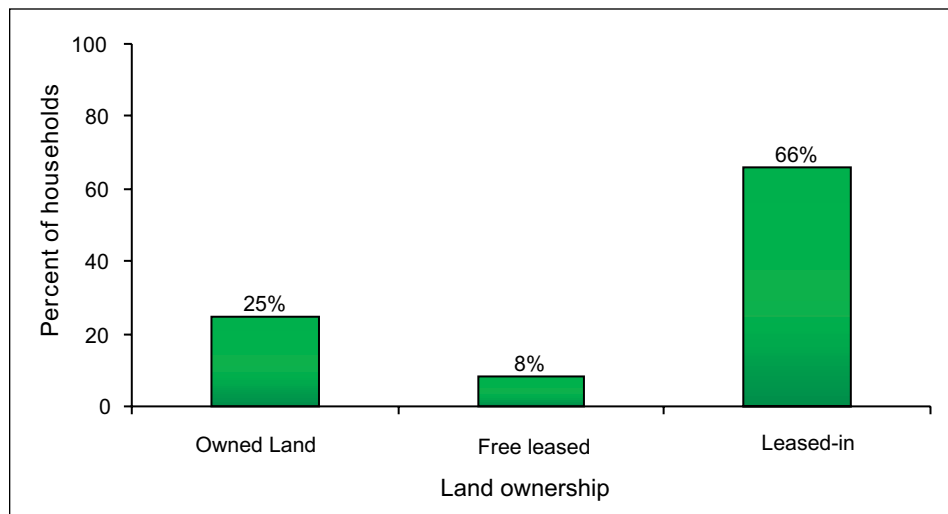
³ A sample of project farmers randomly selected for the import assessment survey

Family size ranges from 1 to 10 people with an average of 4.68 persons. Average number of labor in the family is 2.64 persons (56.31%). 77.3% of the respondents were part of the baseline survey carried out in 2005.

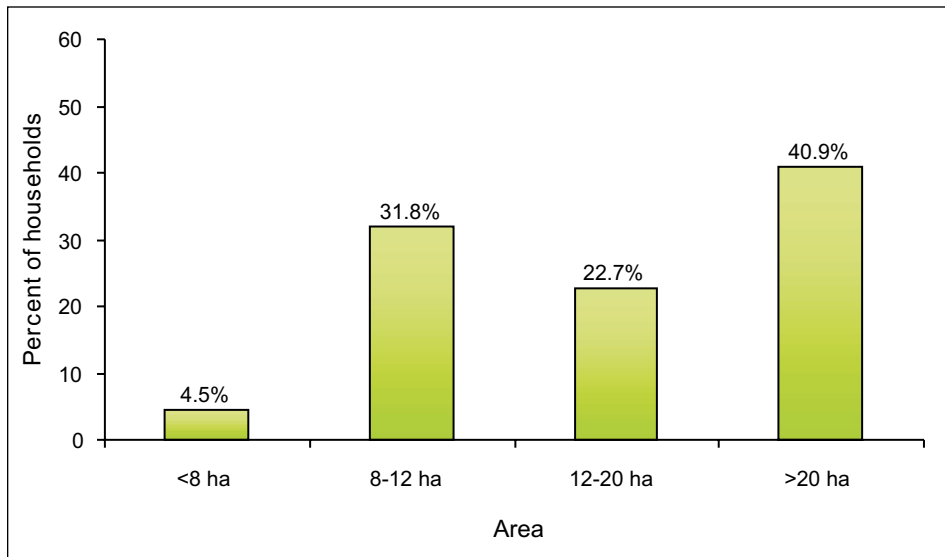
Current land inventory

All of the land under the project area in Nakhon Sawan and Lopburi is rainfed. Average land per household is 88.68 rai (14.19 hectare). 66.63% of the household is leased in (graph 2). Only 25.17% has their owned land and 8.20% has got free land. Check with figure. The rent of the land ranges between 3,750-6,250 baht/hectare. The average land rent is 5,312 baht/ ha. The rent is for 2 crops, the first crop is planted in early rainy season such as corn, sesame, mung bean and pumpkin. Sorghum is the second crop, which is planted in the late rainy season.

The current distribution of household land ownership is shown in graph 3. Most of project farmers have land more than 20 ha (40.9%), followed with 8-12 ha (31.8%).



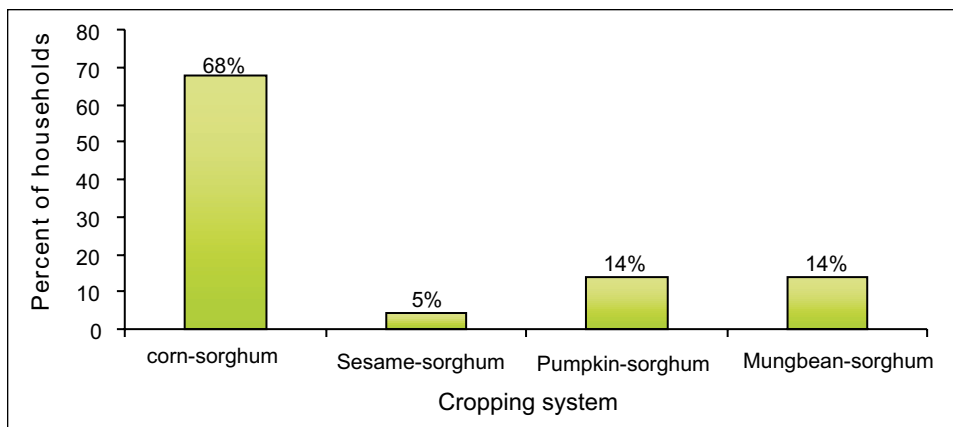
Graph 2. Current household land inventory, 2007.



Graph 3. Household landholding distribution (in hectares).

Cropping pattern in 2007 and area under red sorghum

Red sorghum is the second crop after corn, sesame, pumpkin and mungbean (graph 4). Other second crops are sunflower, mung bean, pumpkin and sesame. From the total land of the project farmers, 55.30% is planted with sorghum. The rest is mainly sunflower planting.

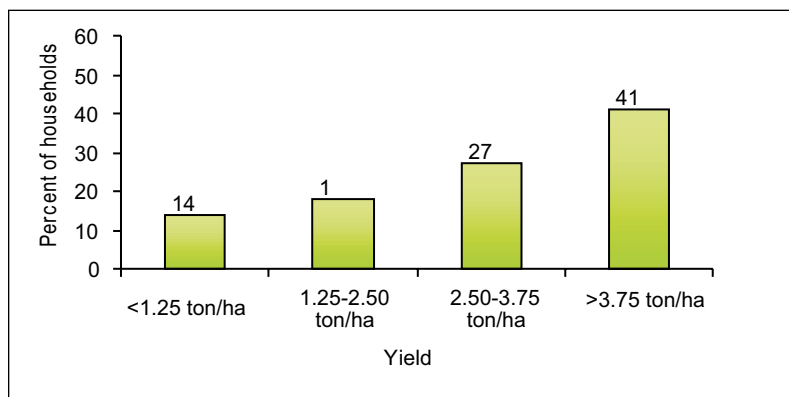


Graph 4. Cropping pattern of red sorghum following the first crop.

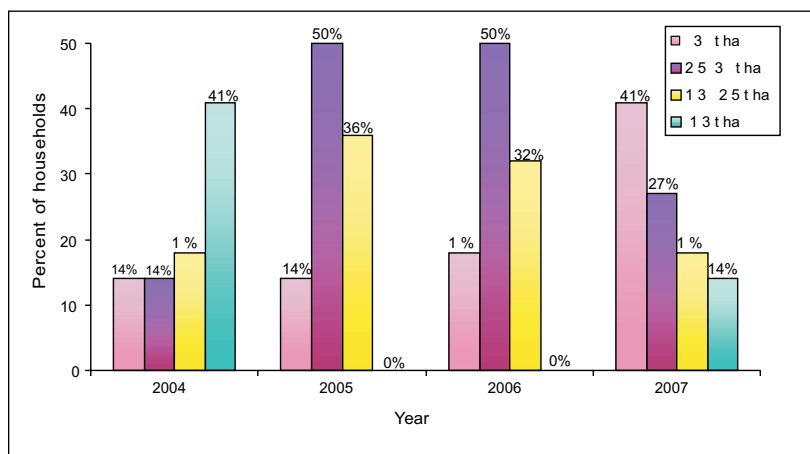
Yields and Harvest Price Information in 2007

The average red sorghum yield in 2007 was 2.95 ton/ha. The highest yield was 4.31 ton/ha. 41% of the household obtained yield more than 3.75 ton/ha and 27% of the household obtained yield between 2.50-3.75 ton/ha (graph 5). 2004 was a drought year and there was very little rain in October. In 2006, the rainfall distribution was better than in 2005, so the average yield was higher. Farmers in 2007 had the highest yields mainly because of good rainfall distribution (graph 6). The average yield in 2004, 2005, 2006 and 2007 were 1.8, 2.6, 2.2 and 2.9 ton/ha respectively.

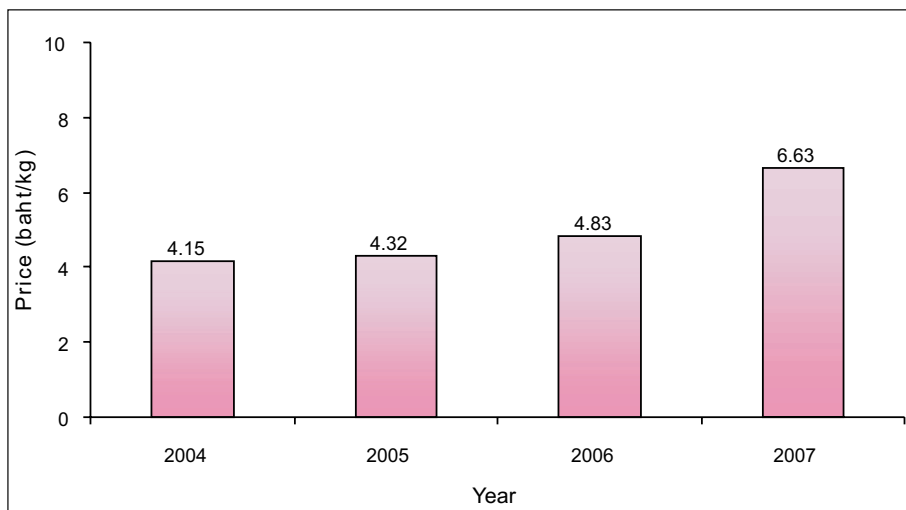
Sorghum price increased significantly over the project years. The price was 4.15, 4.32, 4.83 and 6.63 baht/kg in 2004, 2005, 2006 and 2007 respectively (graph 7).



Graph 5. Distribution of yield of red sorghum, 2007 (t/ha).



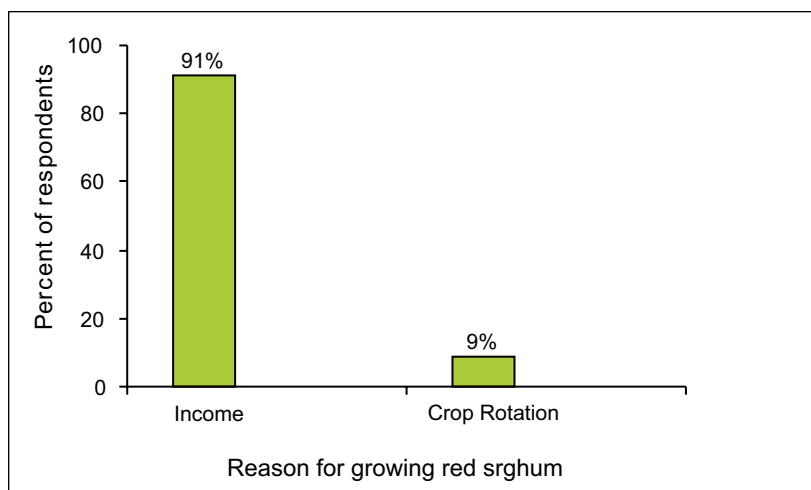
Graph 6. Distribution of yield of red sorghum (t/ha), 2004 to 2007.



Graph 7. Average sale price (baht /kg.) of red sorghum in 2004-2007.

Reasons for growing red sorghum

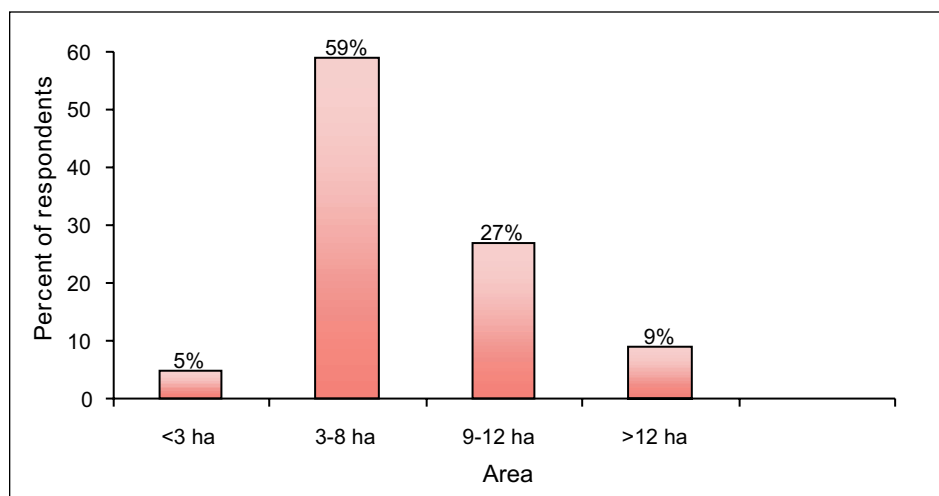
91 percent of the respondents said that they grow sorghum for income. A small percentage of the respondents (9 percent) grew it for crop rotation (graph 8). In this area, there is very little demand from the livestock sector for feed and sorghum stalks are routinely ploughed into the soil.



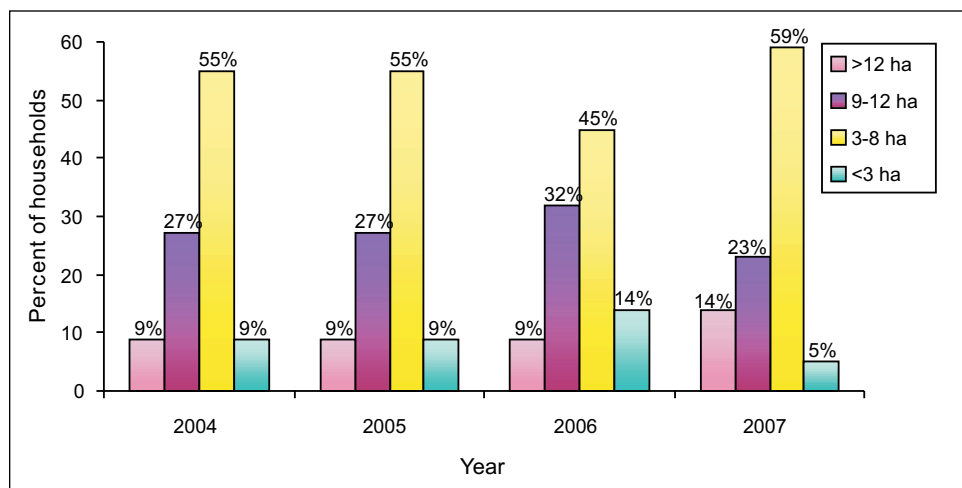
Graph 8. Reasons for growing red sorghum.

Sorghum planting area

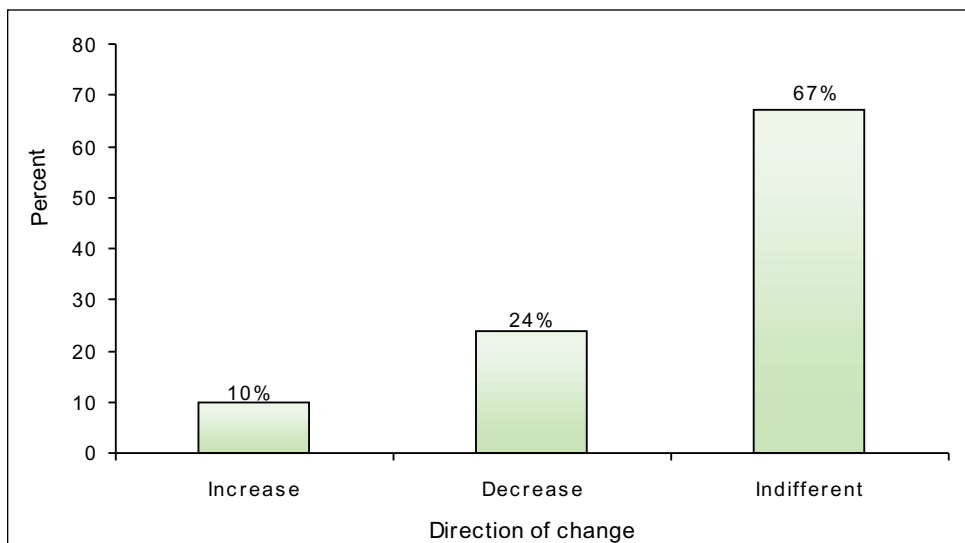
Percentage of farm size of red sorghum in 2004-2007 is shown in graph 9. Average farm size of red grain sorghum is 7.85 hectares. The most common farm size per household ranges between 3 and 8 hectare (59%). The farm size is quite big as it is suitable for machine use for planting and harvesting. There has not been much change in this distribution over the project cycle (graph 10). Sorghum planting area has decreased (graph 11) because new crops are planted instead, such as sunflower, cassava, and mung bean.



Graph 9. Distribution of farm size under red sorghum, 2007.



Graph 10. Distribution of farm size under red sorghum in 2004-2007.



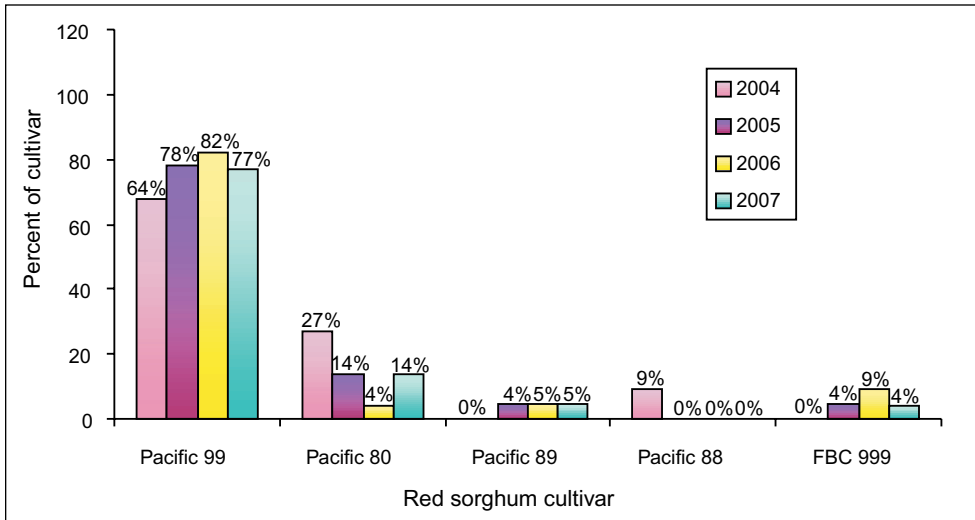
Graph 11. Change in area under red sorghum change between 2004 and 2007.

Sorghum cultivars in 2004-2007

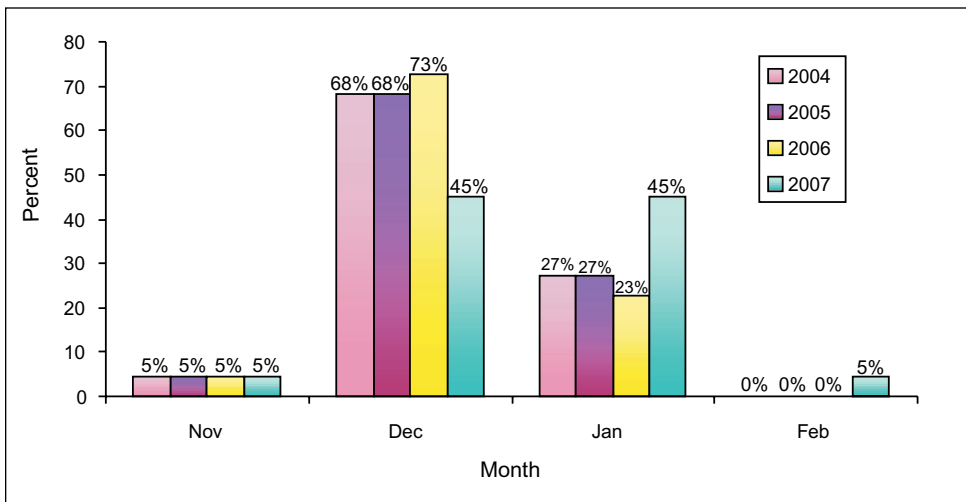
95% of the red sorghum hybrid cultivar is supplied by the Pacific Seed Company. The rest is sourced from Fertilizer and Bioseed Company (FBC). The most popular cultivar of red sorghum is Pacific 99, followed by Pacific 80 (graph 12). Pacific 89 is the newest cultivar which was introduced to the market in 2005.

Primary seed sources are retailers shops near the villages. Where the farmers can get seed or other inputs and sell the produce to the same shop. So the input price is higher because of interest plus.

The harvested crop is sold mainly in December (graph 13), followed in January. In 2007, the planting season is a little bit late so the month sale is in December and January equally.



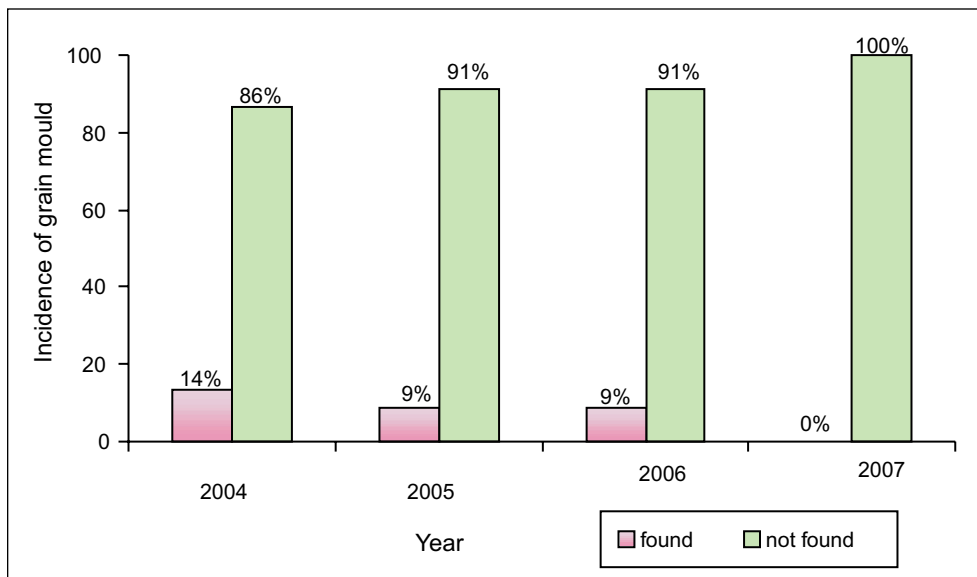
Graph 12. Percentage of red sorghum cultivars used from 2004-2007.



Graph 13. Percentage of sale month for red grain sorghum.

Grain mold

Grain mold has not been a problem over the project years largely owing to the suitable weather conditions. Red sorghum is harvested mainly in January when there is no rain. Grain mold was found 14%, 9%, 9% and 0% in 2004, 2005, 2006 and 2007 respectively (graph 14).

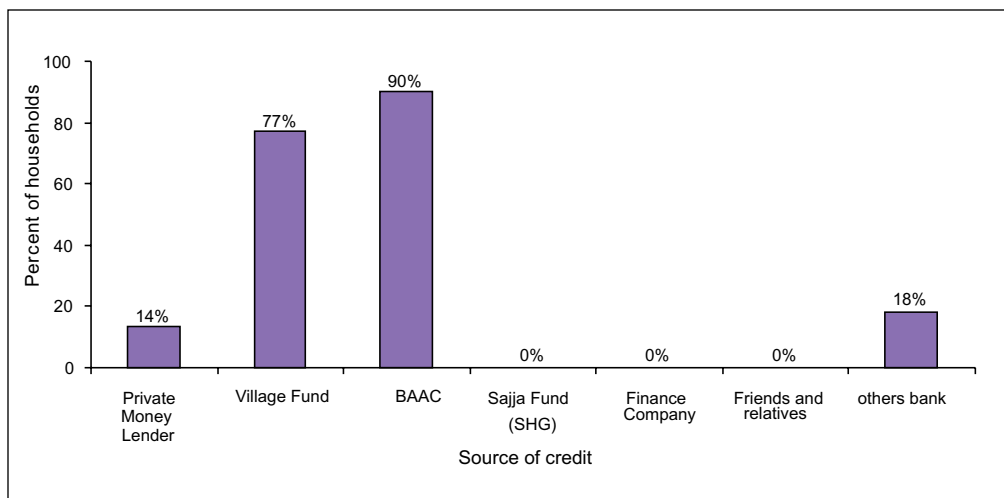


Graph 14. Incidence of grain mold, 2004-2007 (%).

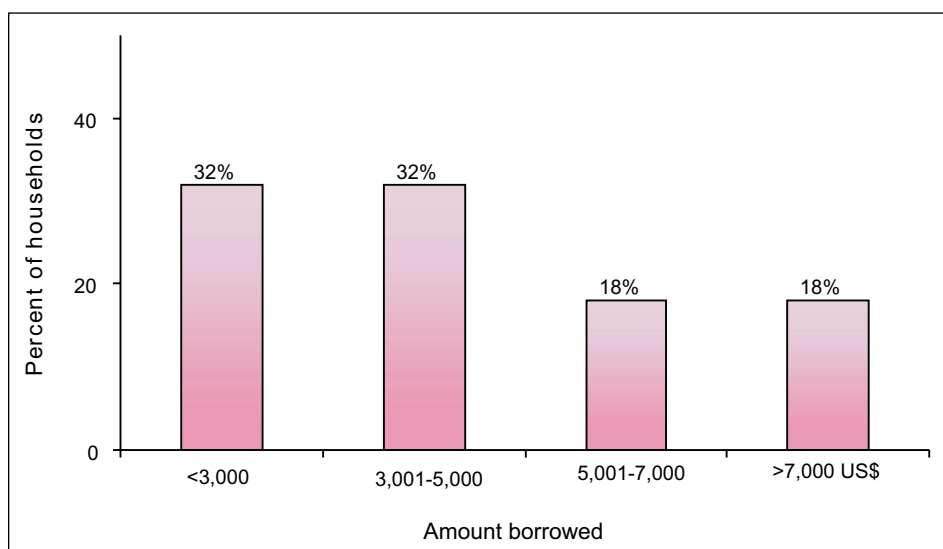
Current sources of agricultural credit

All respondents have access to agricultural credit. 90% of the households have availed loans from Bank for Agriculture and Agricultural Co-operatives (BAAC), followed with 77% from Village Fund (graph 15). The interest rate of BAAC is between 6-12 baht/year but the interest rate of village fund is only 5 baht/year. Most of the respondents have more than one source of agricultural credit. Only 22.7% have a single source of credit.

Total amount borrowed is very large between 30,000-900,000 baht with average of 186,954 baht (5,665 US\$). 32% of the respondents had loans less than 3,000 US\$, 32% had loans between 3,001 and 5,000 US\$, 18% have loans between 5,001 and 7,000 US\$ and the remaining 18% have loans of more than 7,000 US\$ (graph 16).



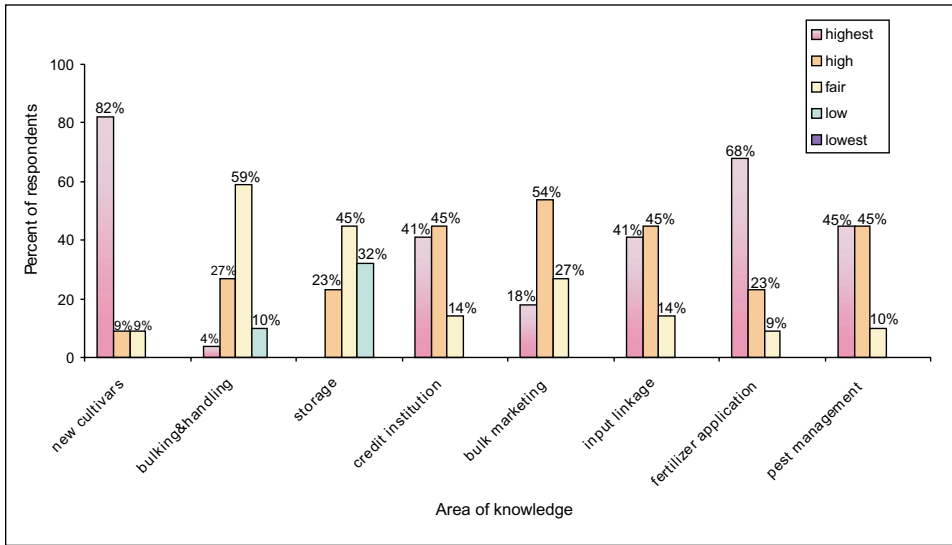
Graph 15. Source of agricultural credit (% borrowed).



Graph 16. Distribution of credit in dollars.

Information on knowledge acquired through project

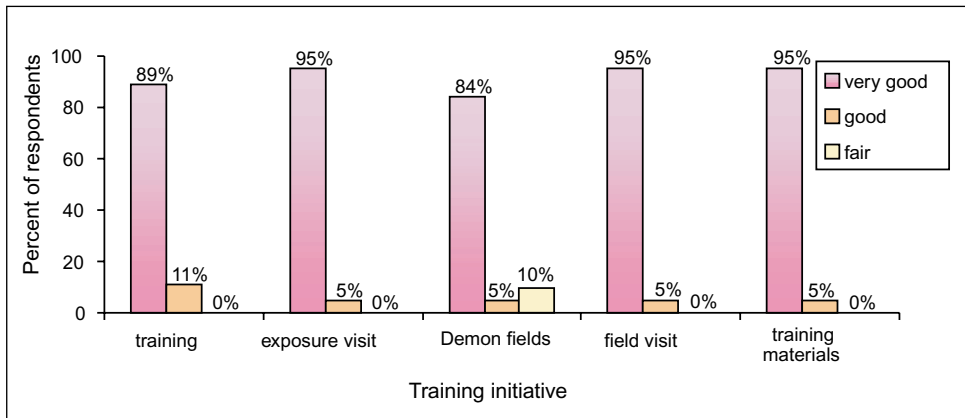
The respondents gave the highest score to knowledge obtained on new cultivars, fertilizer application, credit institution and input linkage as shown in graph 17. The lowest score is on bulking& handling, storage and bulk marketing respectively.



Graph 17. Farmers' perceptions on information obtained through the project.

Training initiatives

The respondents are satisfied with all activities such as training, exposure visit, demonstration fields, field visit and training materials as shown in graph 18. All activities are graded very good.



Graph 18. Household ranking of various training initiatives conducted under the project.

Input-Output Information

Crop:	Red grain sorghum
Province:	Nakhon Sawan and Lopburi
Year:	2007
No. of respondent:	22 (16 males and 6 females)
Total area:	176.64 hectare
Total yield:	520,145 kg or 2.94 ton/hectare ⁴

Activity-wise break-up of cost of production

Cost heads	Total cost(baht/ha)	Total cost (US\$/ha)
Land preparation	2,962	89.77
Sowing	1,417.4	42.95
Harvesting	1,562.5	47.35
Threshing	1,168.8	35.42
Total	7,111.2	215.5

1.1 US\$= 33 baht

Benefit and cost analysis:

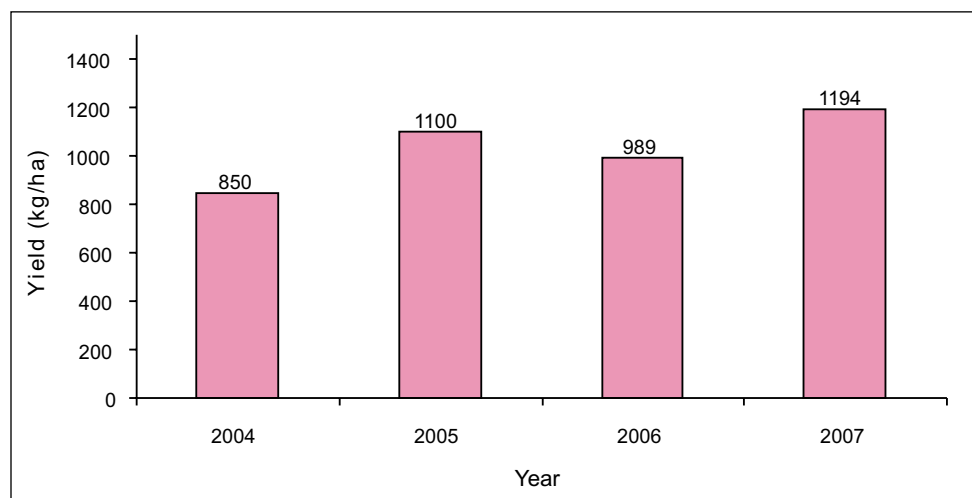
Variable	Baseline Sample (2004)	Project Sample (2007)	Per cent Increase
Cost of cultivation (baht/ha)		7,111.2	
Grain yield (ton/ha)	1.48	2.94	98.6
Prices obtained for grains (baht/Kg)	3.8	6.63	74.5
Gross returns from grains (baht/ha)	5,624	19,492.2	248.1
Net returns (baht/ha)	1,068	12,381	
B:C Ratio	0.23	1.74	

⁴ To refer to costs and profit calculation in terms of rai, (local thailand unit) refer to Appendix 2

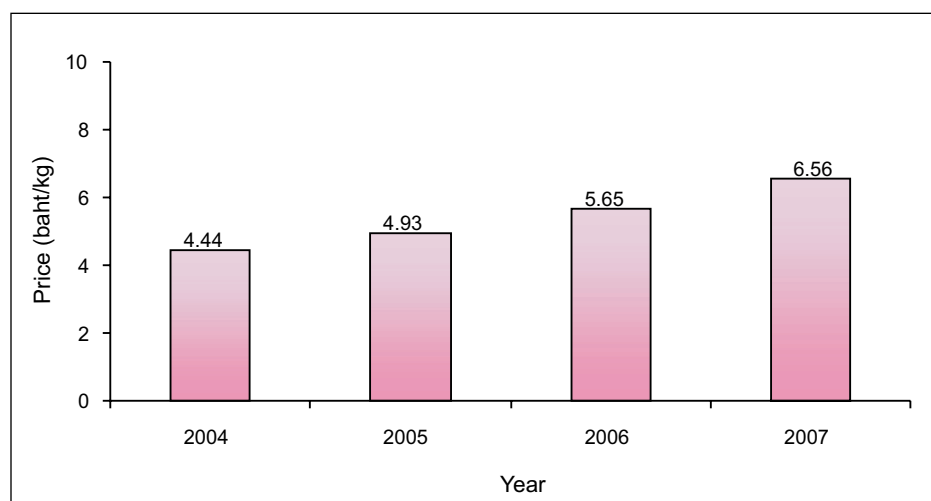
Chapter IV: Summary of key findings

Increase of income

Yield of white sorghum from 2004 to 2007 increased significantly as shown in graph 1. Yield varied mainly because of rainfall. However, the introduction of new cultivars and good seed quality under the project were other reasons for the increase in grain yields. Sorghum price also increased significantly due to increase in world market demand (graph 2).



Graph 1. Average yield of white sorghum (kg/ha) from 2004 to 2007.



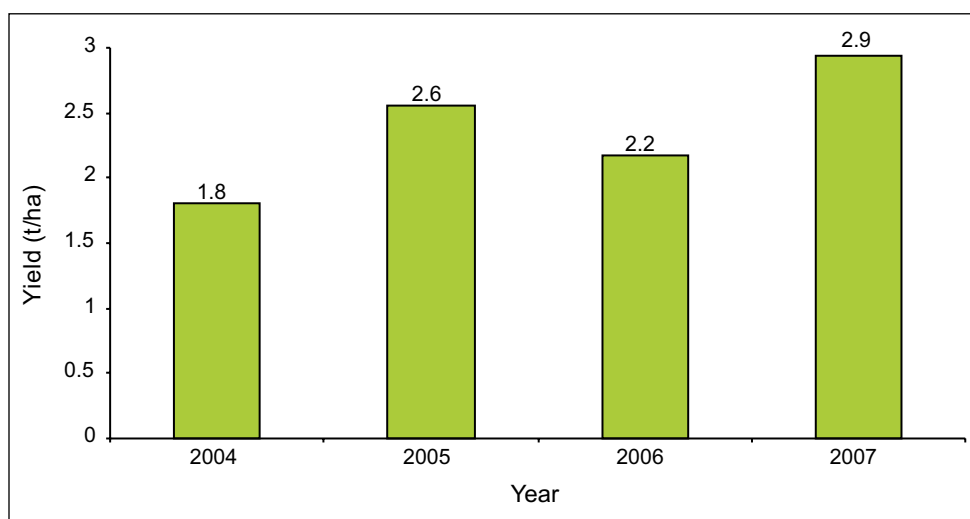
Graph 2. Average price (baht/kg) of white sorghum from 2004 to 2007.

In comparison to the baseline, both sorghum yield and price have increased in 2007. As a result the income was double in 2007 (108% increase from 2004) as in Table 1.

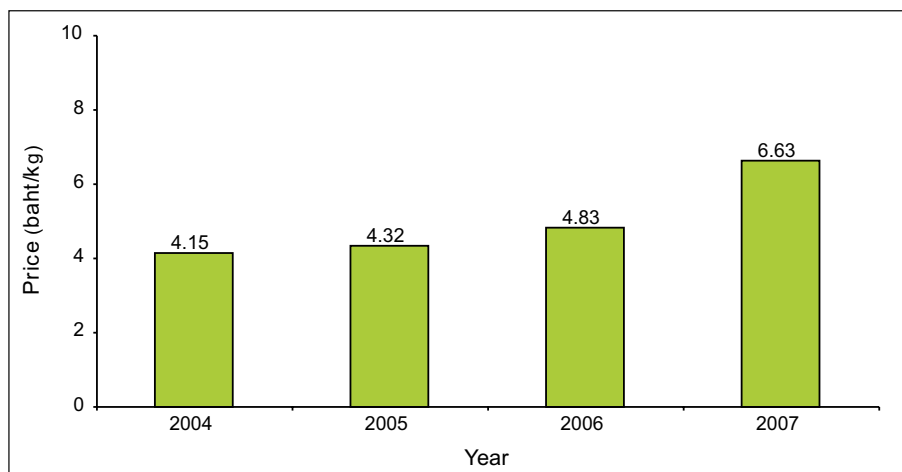
Table 1. Summary of increase of income in white sorghum planting area in Suphan Buri and Kanchanaburi.

	2004	2005	2006	2007
Yield (kg/ha)	850	1100	989	1194
Price (baht/kg)	4.43	4.93	5.65	6.56
Income (baht/ha)	3,765.5	5,423	5,587.85	7,832.64
Income (US\$/ha)	114.11	164.33	169.07	237.30
Index	100	144	148	208

Yield of red sorghum from 2004 to 2007 also increased significantly as shown in Graph 3. Sorghum price has also increased (Graph 4).



Graph 3. Average yield of red sorghum (t/ha) from 2004 to 2007.



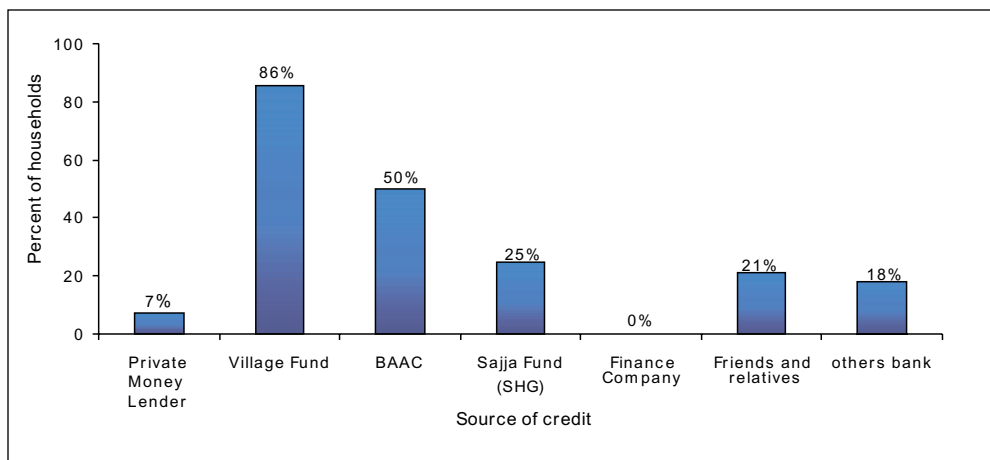
Graph 4. Average price (baht/kg) of red sorghum from 2004 to 2007.

Table 2. Summary of increase of income in red sorghum planting area in Nakhon Sawan and Lopburi.

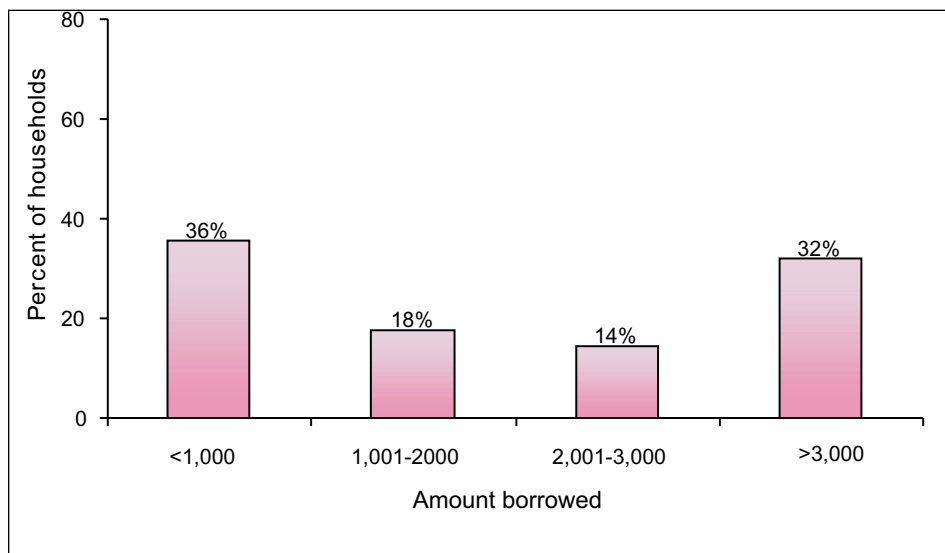
	2004	2005	2006	2007
Yield (kg/ha)	1,812.5	2,556.3	2,168.8	2,943.8
Price (baht/kg)	4.15	4.32	4.83	6.63
Income (baht/ha)	7,521.9	11,043.2	10,475.3	19,517.1
Income (US\$/ha)	227.93	334.64	317.43	591.43
Index	100	147	139	259

Credit

In 2007 10 percent more respondents accessed credit compared with the credit in 2004. The loans were used for other purposes and for sorghum production. The borrowed amount of credit was between 10,000-490,000 baht with an average of 38,553 baht (US\$ 1,168).

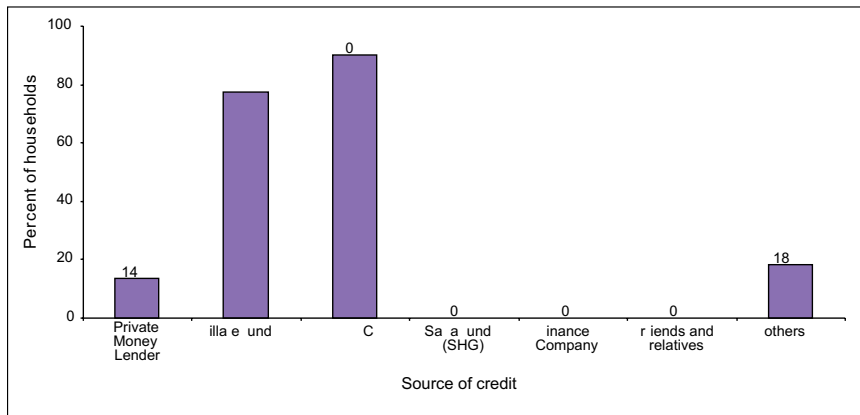


Graph 5. Percentage of household accessed agricultural credit' sources from project farmers in Suphan Buri and Kanchanaburi.

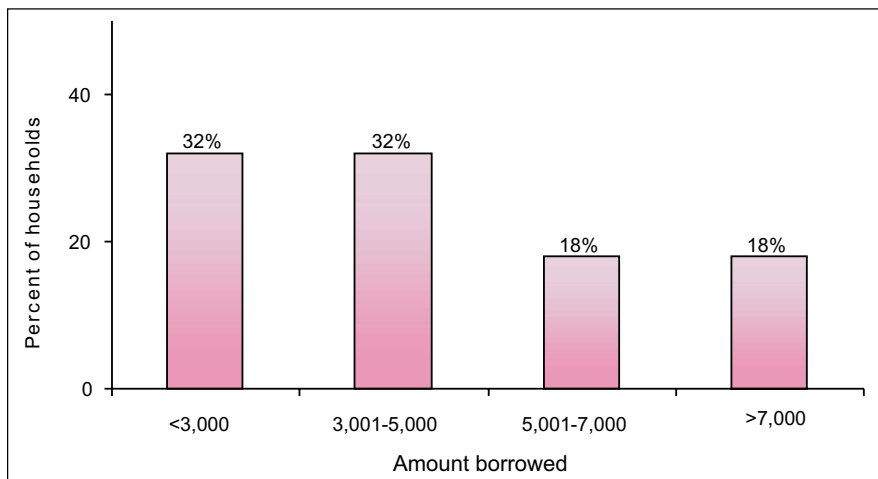


Graph 6. Percentage of amount borrowed credit/ household in US\$.

In Nakhon Sawan and Lopburi, the major source of credit was the BAAC with 90% of the respondents availing of loans from there (graph 7). They guaranteed their loans with land right papers as the amount borrowed was a large. The amount borrowed ranged from 30,000-900,000 baht with the average of 186,954 baht (5,665 US\$). 32% of the respondents borrowed less than 3,000 US\$ and 32% of the respondents borrowed between 3,001-5,000 US\$ (graph 8).



Graph 7. Percentage of household accessed agricultural Credit' sources from project farmers in Nakhon Sawan and Lopburi.



Graph 8. Percentage of amount borrowed credit in US\$.

Marketing

The bulk marketing component of the project was not applicable to Thailand because the sorghum is sold immediately after threshing. Farmers have no storage for big amount of sorghum and do not have access to a drying facility. However, white sorghum was introduced in new planting area in Nakhon Sawan and Lopburi with the amount of 2,100 kg or 70 sacks (30 kg/sack) which can be planted in over 6,250 ha. This seed was planted in August 2008 for the niche market of mushroom farms.

The godowns at Jorakhe Sampan, Suphan Buri and Loakwan, Kanchanaburi are used for seed storage. There are seed villages for white sorghum, paddy seed etc.

Chapter V: Stake-holders' Opinion Analysis

Name of Respondent: **Mr Pachok Pongpanich**
Designation: **Managing Director**
Organization: **Pacific Seeds (Thai) Ltd.,**
Place: **Saraburi, Thailand**
Date: **Jan 25th, 2008**
Mailing address: 1 Moo 13, Paholyothin Road, Phraputthabat,
Saraburi 18120
Email: pp@pacthai.co.th
Telephone: +66 36 266316-9;
Mobile: +66 81 9426172

1. Describe the role you and/or your organization has played in the project.

The Pacific Seeds Ltd has participated in the project meeting to better understand sorghum project to boost sorghum crop production and yield in Thailand and to share information on sorghum production in Thailand. It took part in a joint promotion activity to educate groups of farmers in key territories on improved production technologies that enhance yields. The company also provided good quality seed at special prices to group of farmers. It also hosted groups of farmers at the research farm to demonstrate sorghum model farm.

2. How have you and/or your organization benefited from the project?

As a major seed supplier, the more the sorghum areas expand the more the seed sold. This is a real benefit from this project.

3. Has the project has been able to change the livelihood of the small and marginal farmers? What was the contribution of you/ your organization in the effort?

Yes, it has. But the project is covered only small part of the total sorghum growing areas. There are a few groups of farmers who could benefit from this project. Most of contribution made was to educate farmers to know the best agronomy practices procedure in order to improve grain yield per unit area.

4. Give your opinion on how well the project was implemented. What were the constraints faced? Please give suggestions as to how it could have been implemented in a better manner.

Implementation: Time frame to implement in regard to farmer meeting sometime was late. The project began after planting time started. The way the project team made appointment with farmers in some year was not the right time to promote the crop. Planning should be matched with planting pattern in targeted areas. As sorghum planting time varies year on year up to corn crop. So project team must follow the cropping pattern year by year to approach farmers at the right time.

Constraints faced: Limited in budget affected to the size of areas coverage to promote and educate farmers in wider areas.

Suggestions to improve: Project should cover in wider areas and don't need to focus in progressive zones as farmers in these areas known well about sorghum.

5. What are the steps that the project management can take now to make the project sustainable in the long term? What could be your/your organization's specific contribution?

List key factors to help sustain the project: Under the high grain price situation due to increasing demand for raw material for ethanol production, raw material for feed mill will receive good price. So farmers should have made profit from sorghum crop for few more years. The project can help in sustaining its activities by low cost of production and survive limited moisture in the late season crop along with good grain price will sustain farmers to earn reasonable incomes in second crop.

Our organization can play a role in sustaining the project by:

- Supplying high quality seed
- Educating farmers to understand to do good cultural practices to achieve high yield potential and to make profit from sorghum crop from low cost of production
- Working with other inputs organizations to join promotion to boost yield per unit area
- Working with feed mill industry to promote the use of sorghum as raw material

Name of Respondent: **Mr Sukasame Chitsing**
Designation: **Manager**
Organization: **Fertiliser and Bioseeds Co., Ltd.**
Place: **Lopburi**
Date: **Feb.15th, 2008**
Mailing address: 99/35-36 Moo-1, Tumbon Khaosamyod, A. Muong, Lopburi 15000
Email: **c_sukasame@yahoo.com**
Telephone: **+66-3662-7656;**
Mobile: **66-81-8562231**

1. Briefly describe the role you and/or your organization has played in the project.

Our organization cooperated on the project, promotion, training, and demonstration.

2. How have you and/or your organization benefited from the project?

Yes, the farmers will know the benefit of new hybrid varieties, FBC-111, FBC-999. SCR (Social cooperated responsibility) is one of company's policies to share profit to community.

3. Has the project has been able to change the livelihood of the small and marginal farmers? What was the contribution of you/ your organization in the effort?

Farmer is more interesting to grow grain sorghum in their farm.

4. Give your opinion on how well the project was implemented. What were the constraints faced? Please give suggestions as to how it could have been implemented in a better manner.

Implementation: It would be better to work directly with the farmer in advance.

Constraints faced: There was very little financial support given to the farmers and the disbursement was too slow to get the work done properly or get a good result.

Suggestions to improve: Continue to support financial and planning the time table in advance.

5. What are the steps that the project management can take now to make the project sustainable in the long term? What could be your/your organization's specific contribution?

List key factors to help sustain the project: Continue on the training / demonstration every year by moving from the old area to new area.

Our organization can provide support on the training and demonstration program.

Name of Respondent: **Mr Thamrongsilpa Pothisoong**
Designation: **Director**
Organization: **National Corn and Sorghum Research Center**
Place: **Nakhon Ratchasima, Thailand**
Date: **Jan 31st 2008**
Mailing address: 298 Mitrapab Road, Klangdong, Pakchong, Nakhon Ratchasima, 30320.
Email: ijsthp@ku.ac.th
Telephone: +66-44-361770-4; Mobile:+66-89 5803397

1. Briefly describe the role you and/or your organization has played in the project.

Our organization has participated in the project meeting to share information on sorghum research, application and production in Thailand. We educated the target group of farmers to increase their production technology and income through training, demonstration and workshop. We also provided information and some white sorghum seed for the target group.

2. How have you and/or your organization benefited from the project?

National Corn and Sorghum Research Center is a non-profit center of Kasetsart University, with an emphasis on research and research service on field crops improvement and production. The information and knowledge exchange from this project are key vision for our researchers to propose their research projects and technology transfer to benefit users especially farmers.

3. Has the project has been able to change the livelihood of the small and marginal farmers? What was the contribution of you/ your organization in the effort?

The project is able to change the livelihood of the small scale and marginal farmers. But it covered only small area of sorghum plantation region.

Our contribution was to educate the target group of farmers about sorghum production in various cropping systems and to encourage farmers to apply appropriate technology on their farms.

4. Give your opinion on how well the project was implemented. What were the constraints faced? Please give suggestions as to how it could have been implemented in a better manner.

Implementation: Project planning had very good steps of working, but implementation period in some area was not suitable to cropping pattern. It was late in some target areas.

Constraints faced: Competitive crops such as sunflower (for tourism) and government policy (promotion of energy crops such as sugarcane, cassava, and physic nut etc.) made farmers in difficulty to decide to join the project, because they need low investment, simple cultural practices, and financial support at the beginning.

Suggestions to improve:

- Implementation should be in time.
- Financial support is important to promote for wider areas (only for the first crop).

5. What are the steps that the project management can take now to make the project sustainable in the long term? What could be your/your organization's specific contribution?

List key factors to help sustain the project:

- Benefit from sorghum production over competitive crops, it could be in term of income, low cost of investment, simple cultural practice, or various kind of utilization.

- Follow up by project coordinator or promotion team to encourage farmers to grow sorghum under suitable situation and cropping pattern.

Role of your organization to sustain the activities with farmers:

- National Corn and Sorghum Research Center open 4-5 training courses a year for farmers to transfer appropriated technology in field crops production.
- Promote and supply high quality seed of both red grain and white grain sorghum for farmers.
- Work with private seed companies and feed mill industry to improve sorghum production, quality and utilization.
- Encourage farmers to use their farmland and farm resources fruitfully, whole year round.

Details of Farmers' Associations

Country/State/Province:	Thailand/Suphan Buri
Cluster / village:	Jorake Sampan
Name of respondent:	Mr. Kamjad Changkeaw
Status in FA:	Leader
Name of the Association:	White sorghum planters' group
Number of farmer members:	29
Village:	Jorake Sampan
Membership fees:	None
Number of committee members:	3

Main responsibility & functions carried out by this Association under the project.

- Warehouse management
- Linkage market with users
- Seed distribution to members

Majority opinion on formally registering the Association

The members did not favor the registration of the Association

Details of other welfare programs carried out/ to be carried out

The profit from village fund is used for scholarship, cremation, loan and emergency credit etc. There is also budget from Regional Administration Office for welfare program such as training, cultural conservation, old people allowance (500 baht monthly), sport, community events and etc.

Details of other associations and/ or farmer groups already in the village

There are 2 associations and 3 groups. For registration as association (1 and 2), the fund is at least 1 million baht and there has to be an account inspector.

S.no	Type of function	Constraints encountered	Suggestion for improvement
1	Village fund(Village bank)	-	
2	Irrigation users cooperatives	Conflict in water use between paddy field and fish farm	Negotiation
3	OTOP (One tambol one product; woman group)	Market	Find new market
4	Organic farmersGroup & Rice seed village bank	Low yield, market	Marketing

Country/State/Province: Thailand/ Kanchanaburi

Cluster / village: Laokwan

Name of respondent: Mr. Somkiet Sampoathong

Status in FA: Leader

Name of the Association	White sorghum planters' group
Number of farmer members	55
Village	Laokwan
Membership fees	None
Number of committee members	5

Main responsibility & functions carried out by this Association under the project.

- Warehouse management
- Seed distribution to members
- Linking members with the project team for joint activities

Majority opinion on formally registering the Association

The members did not favor the registration of the Association

Details of other welfare programs carried out/ to be carried out

Yes, such as training, sport, social events.

Details of other associations and/ or farmer groups already in the village

There are only groups and no associations in the village

S.no	Type of function	Constraints encountered	Suggestion for improvement
1	Village fund	Villagers spend loans for others, not for crops.	Spend less + sufficient economy
2	Sajja fund (SHO)	Members have not much money to save, some wants more credit.	Income will be increased if crops' prices increase.

Appendix

Appendix 1:

Input-Output Information Module:

Crop:	White grain sorghum
Province:	Suphan Buri and Kanchanaburi.
Year:	2007
No. of respondent:	29 (18 males and 11 females)
Total area:	1,022 rai (163.5 hectare)
Total yield:	195,000 kg (190.8 kg/rai=1.19 ton/hectare)

Operations	Input/Output					
		Unit	Quantity	Unit price	Total material cost(baht/rai)	Total material cost(US\$/ha)
1. Land preparation (Plowing)	M	D	-	-	-	-
	F	D	-	-	-	-
	B	D	-	-	-	-
	T	H	1	250	250	47.35
2. Date of sowing						
Planting/Sowing/re-sowing	M	D	-	-	11.45	2.17
	F	D	-	-	-	-
	B	D	-	-	-	-
	T	H	-	-	-	-
3. Seed quantity:	-	KG	5.5	10.6	58.3	11.02
4. Harvesting ² :	M	D	-	-	143.94	27.26
Date of Harvesting: Crop2 Crop3						
5. Threshing	F	D	-	-	-	-
	HR	H	-	-	-	-
	M	D	-	-	-	-
5. Threshing	F	D	-	-	-	-
	B	D	-	-	-	-
	TH	H	-	-	76.98	14.58
6. Main production (grain yield)	1.19	Tons	-	-	-	237.30
7. By-product (Fodder yield)	16.25	Tons	-	-	-	49.24

¹ Labor input includes total labor days of family and hired labor for each operation. Specify male and female labor.

² Estimate the labor requirement if you had given to contractor for harvesting.

M = Male labor, F = Female labor, B = Bullock pair labor,

T = Tractor/Truck, TH = Thresher, HR= Harvester, SP = Sprayer, DU = Duster.

Units: D=Day, H=Hour, KG= Kilogram, and LT=Liters

Note : Cost of hiring tractors\bullocks pair includes operator.

Cost of Production

1. Land preparation (plowing) cost

There is only one plough for white sorghum land preparation using 7-disc plough tractor. The average input cost is 250 baht/rai with the range between 240-300 baht/rai. So the total cost for land preparation is 47.35 US\$/hectare.

2. Sowing (planting) cost

Actually, the sowing is done before plowing, the cost is varied from 2.6-33.5 baht/rai depend on the size of sorghum fields and the distance. In general, they do it themselves (family labor). The average sowing cost is 11.45 baht/rai (2.17 US\$/hectare).

3. Seed cost

All seed used are 5,645 kg in the area of 1,022 rai. So the average of seed used is 5.5 kg/rai (34.3 kg/ hectare) which is very high. The seed cost is between 8-15 baht/kg with the average of 10.6 baht/kg. So the seed cost is 11.02 US\$/hectare.

4. Harvesting cost

The average of harvesting cost is 143.94 baht/rai with the range between 65-360 baht/rai depend on the quantity of sorghum yield. So the total harvesting cost is 27.26 US\$/hectare.

5. Threshing cost

The average of threshing cost is 76.98 baht/rai with the range between 40-195 baht/rai. So the total threshing cost is 14.58 US\$/hectare.

6. Grain yield

Total yield from 1,022 rai (163.5 hectare) is 195,000 kg. So average grain yield in 2007 is 190.8 kg/rai (1.19 ton/hectare).

7. By product (fodder yield)

The average fodder yield is 2.6 ton/rai (16.25 ton/hectare). The price is 100 baht/ton.

Income

1. Grain yield income = $1,194 \text{ kg} \times 6.56 \text{ baht/kg} = 7,832/33 = 237.30 \text{ US\$/hectare}$.

2. Fodder yield income = $16.25 \times 100 = 1,625/33 = 49.24 \text{ US\$/hectare}$.

(Average fodder yield = 2.60 ton/rai = 16.25 ton/ha, fodder price = 100 baht/ton for grazing)

3. Total income = $237.30 + 49.24 = 286.54 \text{ US\$/hectare}$.

Profit

Total income = $237.30 + 49.24 = 286.54 \text{ US\$/hectare}$.

Cost of production = 102.38 US\$/hectare.

Profit = 286.54 - 102.38 = 184.16 US\$/hectare.

Note: 1 US\$ = 33 baht

Appendix 2:

Crop:	Red grain sorghum
Province:	Nakhon Sawan and Lopburi
Year:	2007
No. of respondent:	22 (16 males and 6 females)
Total area:	1,104 rai (176.64 hectare)
Total yield:	520,145 kg (471.14 kg/rai = 2.94 ton/hectare)

Operations	Input/Output					
		Unit	Quantity	Unit price	Total material cost(baht/rai)	Total material cost(US\$/ha)
1. Land preparation (Plowing)	M	D	-	-	-	-
	F	D	-	-	-	-
	B	D	-	-	-	-
	T	H	1	250	474	89.77
			2	550		
2. Date of sowing						
Planting/Sowing/re-sowing	M	D	-	-	-	-
	F	D	-	-	-	-
	B	D	-	-	-	-
	T	H	1	100	100	18.94
3. Seed quantity:	-	KG	1.35	94	126.9	24.03
4. Harvesting ² :						
Date of Harvesting: Crop2 Crop3	M	D	-	-	-	-
	F	D	-	-	-	-
	HR	H	1	250	250	47.35
5. Threshing	M	D	-	-	-	-
	F	D	-	-	-	-
	B	D	-	-	-	-
	TH	H	-	-	-	-
6. Main production (grain yield)	2.94	Tons	-	-	-	-

¹ Labor input includes total labor days of family and hired labor for each operation. Specify male and female labor.

² Estimate the labor requirement if you had given to contractor for harvesting.

M = Male labor, F = Female labor, B = Bullock pair labor,

T = Tractor/Truck, TH = Thresher, HR= Harvester, SP = Sprayer, DU = Duster.

Units: D=Day, H=Hour, KG= Kilogram, and LT=Liters

Note: Cost of hiring tractors\bullocks pair includes operator.

Cost of Production

4. Land preparation (plowing) cost

For Red sorghum, land preparation is one or two plough using 3 or 3 and 7-disc plough tractor. The average plowing cost is 474 baht/rai with the range between 200-550 baht/rai. 59% of the respondents used 2 plough for land preparation. So the total cost for land preparation is 89.77 US\$/hectare.

5. Sowing (planting) cost

Planting for red sorghum is usually done by machine with the fix cost 100 baht/rai. (18.94 US\$/hectare).

6. Seed cost

Seed used is hybrid cultivar. For 1 box (20 kg) can be used in the area of 15 rai when broadcast by machine. By row planting, the seed rate is less (1.2-1.3 kg/rai). So the average of seed used is 1.35 kg/rai (8.43 kg/ hectare). The seed cost is between 1,800-1,950 baht/20 kg with the average of 1,880 baht/box or 94 baht/kg. So the seed cost is 24.01 US\$/hectare).

4. Harvesting cost

Red sorghum is harvested by machine with fix cost- 500 baht/ton or 250 baht/rai. By hand, the

average of harvesting cost is 145 baht/rai with the range between 128-256 baht/rai depend on the quantity of sorghum yield (threshing not included). 91% of the respondents harvested sorghum by machine So the total harvesting cost by machine is 250 baht/rai (47.35 US\$/hectare).

5. Threshing cost

The average of threshing cost is 30 baht/100 kg (the labor not included). With labor, the average threshing cost is 187 baht/rai. So the total threshing cost is 35.42 US\$/hectare. Harvesting by hand plus threshing is more expensive than harvesting by machine.

6. Grain yield

Total yield from 1,104 rai (163.5 hectare) is 520,145 kg. So average grain yield in 2007 is 471.14 kg/rai (2.94 ton/hectare).

Income

Grain yield income = 471.14 kg/rai x 6.63 baht/kg = 3,122 x 6.25 /33 = 591.43 US\$/hectare.

Profit

Total income = 591.43 US\$/hectare.

Cost of production = 180.09 US\$/hectare.

Profit = 591.43 - 180.09 = 411.34 US\$/hectare.

Note: 1 US\$ = 33 baht

About CFC



The Common Fund for Commodities (CFC) is an autonomous intergovernmental financial institution established within the framework of the United Nations. The Agreement Establishing the Common Fund for Commodities was negotiated in the United Nations Conference on Trade and Development (UNCTAD) from 1976 to 1980 and became effective in 1989. The first project was approved in 1991.

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The Food and Agricultural Organization (FAO) of the United Nations is an autonomous intergovernmental organization established in 1945, which leads international efforts to defeat hunger. Serving both developed and developing countries, FAO acts as a neutral forum where all nations meet as equals to negotiate agreements and debate policy. FAO is also a source of knowledge and information to modernize and improve agriculture, forestry and fisheries practices and ensure good nutrition for all. The main functions of FAO include collection, analysis, interpretation and dissemination of information relating to nutrition, food and agriculture. It promotes, disseminates and, where appropriate, recommends national and international action with respect to scientific, technological, policies, marketing and distribution, conservation of natural resources, social and economic research relating to nutrition, food and agriculture. It also undertakes the function of furnishing technical assistance to the governments on request, in cooperation with the governments concerned.



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About ICRISAT



The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 600 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT is supported by the Consultative Group on International Agricultural Research (CGIAR).

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