

The Jujube Production System in Ban Meng Sub-district, Khon Kaen Province, Northeast Thailand

Waewdaw Nambutra¹, Bonhee T. Chung², Attasart seansart¹ and A.Terry Rambo¹

ABSTRACT: Jujube is a popular fruit consumed by people in Northeastern Thailand. Jujube trees are drought tolerant and well suited to sandy upland soils. They are also tolerant of soil salinity which is believed to have given a better taste to the fruit. Ban Meng sub-district (tambol) is known as the first area in Khon Kaen province to have started jujube production. Jujube farmers there were interviewed to understand the production system for jujube, assess the costs and benefits of jujube growing, and identify the ecological and social factors that affect success in cultivating this new crop. Although the economic returns are much higher than other upland crops like cassava and sugarcane, farmers need to make a substantial initial investment to establish a jujube orchard, and also need to learn specialized production knowledge and skill. Also, jujube fruit production needs adequate water supply, and high application of expensive inputs including fertilizers, hormones, pesticides and hired labor. Consequently, the agroecological niche of jujube is much narrower than the niches occupied by sugarcane and cassava. Only the farmers who have the necessary resources and growing conditions are able to successfully produce jujube fruit in Ban Meng sub-district.

Keywords: crop diversification, fruit growing, agroecological niche, cost-benefit analysis

บทคัดย่อ: พุทราเป็นผลไม้ประชาชนในภาคตะวันออกเฉียงเหนือ (ภาคอีสาน) นิยมรับประทานเนื่องจากพุทราสามารถทนต่อความแห้งแล้งเจริญเติบโตได้ในสภาพดินทรายและทนทานต่อสภาพดินเค็มซึ่งมีความเชื่อที่ว่าทำให้พุทรามีรสชาติดีขึ้นตำบลบ้านเม็งอำเภอกุเรียดจังหวัดขอนแก่นเป็นที่แรกที่เริ่มปลูกพุทราสามรสในจังหวัดขอนแก่น กลุ่มเกษตรกรที่ให้สัมภาษณ์เกี่ยวกับระบบการปลูกพุทราได้ให้ข้อมูลเกี่ยวกับรายได้ผลกำไรค่าใช้จ่ายรวมไปถึงระบบนิเวศและปัจจัยทางด้านสังคมอื่นๆ ที่มีผลต่อการปลูกพุทราถึงแม้ว่าเกษตรกรจะมีรายได้สูงจากการปลูกพุทรา มากกว่าพืชไร่อื่นเช่นมันสำปะหลังและอ้อยก็ตามแต่เกษตรกรผู้เริ่มปลูกพุทราต้องมีการเตรียมการอย่างมาก ทั้งในส่วนของเงินทุนความรู้และทักษะเฉพาะในการปลูกพุทรา นอกจากนี้การปลูกพุทราต้องมีการให้น้ำอย่างเป็นระบบซึ่งมีต้นทุนสูงและค่าใช้จ่ายในการจัดซื้อปุ๋ยฮอร์โมนยาปราบศัตรูพืชและแรงงานดังนั้นระบบนิเวศเกษตรที่เหมาะสมของพุทราจึงน้อยกว่าเมื่อเปรียบเทียบกับอ้อยและมันสำปะหลังดังนั้นในตำบลบ้านเม็งจึงมีเกษตรกรจำนวนน้อยที่มีทรัพยากรจำเป็นด้านต่างๆ ในการปลูกพุทราและสามารถประสบความสำเร็จในการปลูก

คำสำคัญ: ความหลากหลายในการปลูกพืช, การปลูกไม้ผล, นิเวศเกษตรที่เหมาะสม, การวิเคราะห์ต้นทุนกำไร

Introduction

Fruit production is not widespread in Northeast Thailand because of low soil fertility and lack of water resources. Also, farmers find it

difficult to maintain good quality and high productivity. Most farmers grow rice in lowland paddy fields for home consumption and sale, and also grow cash crops, such as sugarcane and cassava, in upland fields. However, in recent

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years, the region has seen a steady growth of fruit production due to a rising demand for fruit in urban markets. Jujube fruit (*Ziziphus mauritiana* Lam.) (Outlaw et al. 2002) has gained popularity in Northeast Thailand in recent years. Ban Meng sub-district, NongRua district, Khon Kaen province is the first of only a few places in Northeast Thailand to specialize in jujube production. Growing jujube began quite recently with one farmer who first planted jujube 12 years ago. By now the number of farmers growing jujube has increased to 13 households in 5 villages. (Ban Meng Tambol Administrative Organization, 2010)

Jujube production is becoming popular because it can generate a substantial income for the farmers, despite facing serious limiting factors. The species tolerates a wide range of temperatures and rainfall, but it requires hot summers and sufficient water for acceptable fruiting. It also requires intensive management as well as high initial investments and external inputs like chemical fertilizer and pesticides. Therefore, farmers we interviewed state that they must deal with high risks and serious difficulties in the management of jujube production. In order to better understand the farmers' decision to grow jujube trees despite these risks and difficulties, this article will describe the jujube production cycle and assess the costs and benefits of jujube production. The agroecological niche of jujube will be described and compared to the niches of cassava and sugarcane, which are the alternative upland crops grown in this sub-district. The findings will help to illuminate the ecological and social factors as well as the economic incentives that are important to the decision making process of the farmers.

Materials and Methods

This study was carried out from November, 2010 to January, 2011 by a team of researchers from Khon Kaen University. Ban Meng sub-district was initially identified as a site for our study after we observed merchants selling jujube fruits from stalls along the roadside. We first asked local informants to help us to identify jujube farmers in the sub-district. Local officials were interviewed to obtain information regarding jujube production in their sub-district. These officers informed us that the Ban Meng sub-district was the first area to start jujube production in Khon Kaen Province. Secondary data were obtained from the sub-district administration office to understand the social and economic contexts of the district.

A total of 13 jujube farmers were identified in the sub-district of whom five participated in individual semi-structured interviews that focused on the jujube production process and the ecological and economic factors influencing successful production of this fruit crop. Detailed information was collected from each farmer on the area planted to jujube, number of trees per rai, average yield per tree, investment costs (land preparation, installation of irrigation system, seedlings, bamboo stakes, fertilizer, and labor) and management costs (fertilizer, pesticides, growth hormones, labor), and average selling price of jujube fruit per kilogram. These data were used to calculate the initial investment cost to establish the jujube orchard, the management cost per crop, and the gross income per crop per rai. Net income was calculated by subtracting management costs from gross income. The time to recover the initial investment cost was

determined by calculating the number of crops needed before net income exceeded the investment cost.

Results and Discussion

The Study Site

Ban Meng sub-district is located about 45 km to the west of Khon Kaen City (Figure 1). About 70-80% of the land area of the sub-district is classified as uplands. The main crops grown are

rice, sugarcane, and cassava. Both soil fertility and rainfall are low as is typical of Northeast Thailand. The most common type of soil is loamy sand. No locally collected rainfall data are available but the average annual rainfall from 2000 to 2010 was 1338 mm at the meteorology station for Khon Kaen province (Ban Meng Tambol Administrative Organization, 2010). Farmers depend on ponds and underground water sources to supply irrigation water for fruit production.

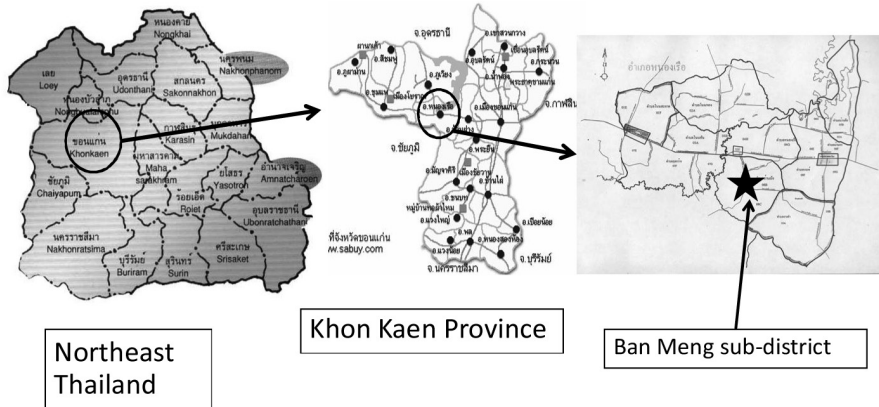


Figure 1 Location of Ban Meng sub-district

The Jujube Production Process

The 4 phases of the jujube production process are shown in Figure 2. These are: 1) Preparation and planting, 2) Growing, 3) Harvesting, and 4) Pruning, after which the production cycle keeps repeating in each

subsequent year. Jujube is not the only crop grown by the farmers in this sub-district and some jujube production activities, particularly harvesting, overlap with those for rice, sugar cane and cassava (Figure 3).

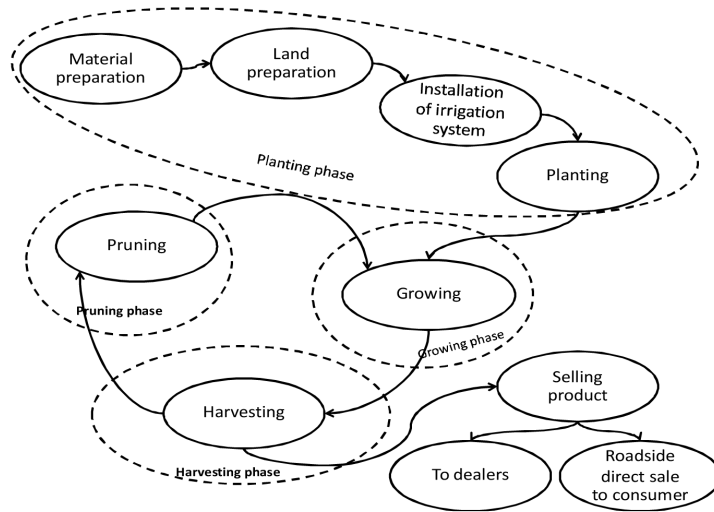


Figure 2 Phases of the jujube production cycle

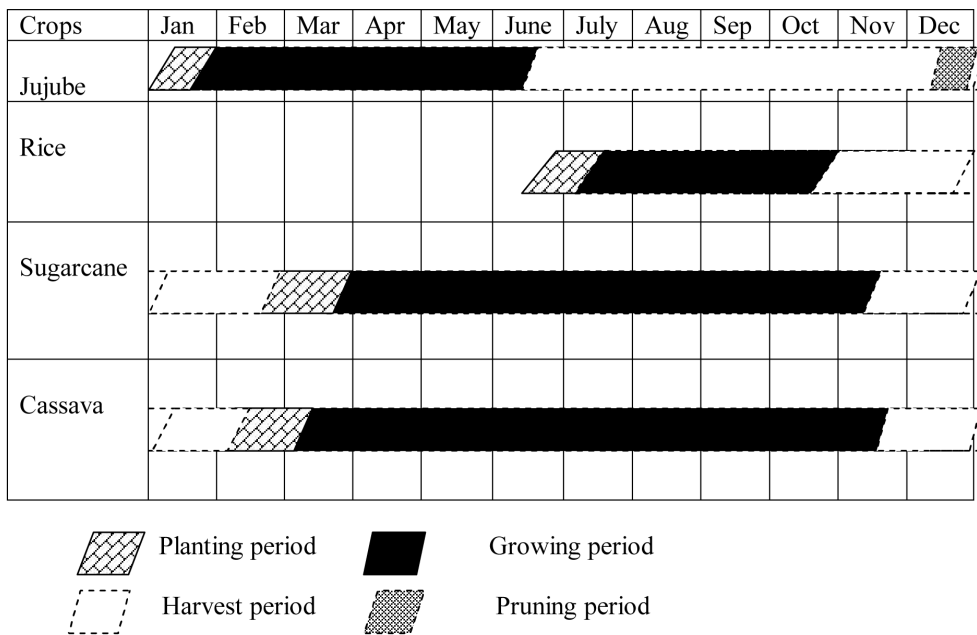


Figure 3 Cropping Calendar in Ban Meng sub-district

1. Preparation and Planting Phase

A. Material Preparation

Jujube seedlings are obtained from nurseries in Ratchaburi province in Central Thailand. The *Sarmrod* variety is preferred by the farmers in Ban Meng sub-district but most of the farmers plant more than one variety, with some growing as many

as 5 varieties. The farmers purchase grafted seedlings for 25 baht each, either directly from a nursery or from a local distributor. The farmers also purchase bamboo poles, which are used to support the seedlings for the first 2 years after planting, for 1 baht/pole.

B. Land Preparation

The farmers hire a tractor along with its operator to plow the land one or two times at a cost of 250-300 baht/rai¹. Some farmers apply chemical or organic fertilizer to enhance soil fertility.

C. Installation of the Irrigation System

The farmers rely on either ponds or wells that tap underground water to provide water needed

for irrigation. The jujube trees require sufficient water in order to fruit successfully. The farmers have to install irrigation systems using equipment such as electric pumps, water storage tanks, pipes and taps, which the farmers can turn on or turn off to supply water around the jujube trees. The costs of setting up the irrigation system are shown in **Table 1**.

Table 1 Cost of installing an irrigation system for a jujube orchard

Irrigation system expenditures	Cost
Water Well	The cost of digging a well ranges from 3,000 to 12,000 baht with an average cost of 9,000 baht, or 285 baht per rai.
Electric pump	The average cost of installing an electric pump is 38,500 baht or 7,700 baht per rai.
Pipe and taps	The average cost of pipe and taps is 4,000 baht per rai.

D. Planting

The planting density of jujube trees varies among the farmers. The highest density is 160 trees per 1 rai with a spacing of 2.5 x 4 meters. The lowest density is 100 trees/rai with a spacing of 4 x 4 meters. Trees planted at a high density are susceptible to the rapid spreading of disease due to the close proximity of the trees to each other; the growth of the trees is also slower due to a lack of light caused by shading. Thus, the farmers who initially planted at high densities were forced later to cut down some of the trees in order to control disease. Seedlings are planted in holes 30-40 centimeters deep. The holes are dug by hand using hoes or spades. Both chemical and organic fertilizers are placed in the hole before the seedling is planted. Two bamboo poles are set up close to each seedling to help support it while it grows. The farmers employ hired laborers to do the planting at a cost of 200 baht per worker per 1 rai per day.

2. Growing Phase

Jujube requires continuous management throughout the year (**Table 2**). Regular application

of foliar fertilizer, growth hormones, and insecticides are required throughout the growing season. Frequent irrigation of the trees is also needed. Farm management activities during the jujube growing, harvesting and pruning phases are shown in **Table 2**.

3. Harvesting Phase

The farmers pick jujube fruits every 2 or 3 days from June to January. The labor requirement during harvesting is heavy and the average daily working time is 10.3 person hours/rai. The farmers hire 4 or 5 workers to harvest fruit for 200 baht/day/worker, although, when the labor demand is high during the rice harvest period, the wage rises to 250 baht/day. Wages account for one-quarter of sales income. The harvest workers use a rope to pull down high branches and a plastic soda bottle attached to the end of a pole as a device for harvesting the fruit. Fruits are sorted by size and packed in 10 kg plastic bags which are sold to middlemen for 13-14 baht/kg or directly to customers on the roadside for 15 baht/kg.

Table 2 Management activities during the annual cycle of jujube production

Month	Management activities
Mid January to March	<ul style="list-style-type: none"> - Watering once a week - Spray foliar fertilizer (16-16-16 & 21-21-21 formula) every 7-15 days - Spray NAA(alpha-naphthaleneacetic acid) hormone on leaves every 7-15 days - Spray insecticides(Hypermethyl 35%, Dimethoate) as needed to control <i>Dropsophilia melanogaster</i>, <i>Bemisiatabaci</i>) - Apply herbicide once a month.
April to May	<p>Flowering period</p> <ul style="list-style-type: none"> - Watering every 3-4 days - Spray foliar fertilizer (21-21-21 formula) every 7-15 days - Spray NAA hormone on leaves every 7-15 days - Stop the use of pesticides to avoid harming bees during the pollination period. - Apply herbicide once a month.
June to September	<p>1st harvesting period</p> <ul style="list-style-type: none"> - Watering once a week - Spray foliar fertilizer (10-52-34 formula) every 7-15 days - Spray NAA hormone on leaves every 7-15 days - Apply calcium boron, carbon dioxin, and sulfur as needed to control <i>Eutetranychusafricanus</i> and prevent sooty mold and black mold - Spray insecticides as needed - Grafting new varieties on the trees to improve productivity.
October to January	<p>2nd harvesting product period</p> <ul style="list-style-type: none"> - Watering every 3-4 days - Spray foliar fertilizer (10-52-34 formula) every 7-15 days - Spray NAA hormone on leaves every 7-15 days - Apply calcium boron, carbon dioxin, and sulfur as needed to control disease. - Spray insecticides as needed - Pruning

4. Pruning Phase

After the end of the harvest period, the farmers prune the jujube trees to stimulate the emergence of new and stronger branches from buds that emerge just below the point where the old branches were cut off. Although un-pruned trees produce fruit, pruned trees will produce more fruit and faster. Also, pruning keeps the plants in better health and makes harvesting easier. The farmers select only 4 or 5 new shoots and leave them to grow for the next flowering season and cut out the remainder. The branches that are cut off are used for firewood and also made into charcoal to be used at home or sold to earn cash income.

Economic Aspects of Jujube Production

Jujube production provides farmers with both cash and in-kind income. According to the statistics of the Office of Agricultural Economics (2010), the average net income from jujube is 40,000-60,000 baht/rai/year in Thailand. This is much higher than other commonly grown upland crops, including sugarcane, which earns 9,000 baht/rai/year, and cassava, which earns 4,000 baht/rai/year. However, as is shown in **Table 3**, the net income per rai of most jujube farmers in Ban Meng is somewhat below the national average, averaging 35,360 baht/rai, with a range from 10,000 to 60,000 baht/rai, which is still

superior to the returns they could obtain from cassava or sugarcane. The initial cost of establishing a jujube orchard is 25,000-28,000 baht/rai, which is much higher than that of a sugarcane or cassava field. However, because jujube produces a crop within the same year in which the trees are first planted, most farmers recover the initial cost within the first year, after which they can expect to earn high profits in

subsequent years. The price of jujube fruits has been stable at 13-14 baht/kg. Also, the farmers can obtain some additional in-kind and cash income from the old branches after pruning that can be used as a firewood for home consumption or made into charcoal to be sold, but this income is not included in our assessment of costs and benefits of jujube production.

Table 3 Cost/Benefit Analysis of Jujube Production (One Crop per Year)

Parameters	Unit	Farmer 1	Farmer 2	Farmer 3	Farmer 4	Farmer 5	Average
Total landholding	Rai	22	6	21	54	7	22
Land allocated for jujube	Rai	5	6	10	3.5	7	6
Spacing	m x m	2.5x4.0	2.5x4.0	4.0x3.0	4.0x4.0	5.0x2.5	3.6x3.3
Planting Area/Tree	m ²	10.0	10.0	12.0	16.0	12.5	11.9
Number of trees/rai	trees/rai	160	160	133	100	128	134
Yield/tree (13 baht/kg)	Kg/tree	58	40	35	15	43	38
Yield/rai	Kg/rai	9,231	6,385	4,615	1,538	5,492	5,452
Total Yield	Kg	46,154	38,308	46,154	5,385	38,446	34,350
Initial Cost (IC) (Seedlings, plowing, irrigation system, bamboo, fertilizer, labor)	baht/rai	28,000	28,500	15,000	20,000	22,000	22,700
Management Cost (MC) (Fertilizer, hormones, pesticides, labor)	baht/rai	60,000	41,600	30,000	10,000	36,000	35,520
Gross Income (GI)	baht/rai	120,000	83,000	60,000	20,000	71,400	70,880
Net income (NI) = (GI-MC)	baht/rai	60,000	41,400	30,000	10,000	35,400	35,360
Time to recover the IC	year	1	1	1	2	1	1
GI/tree	baht/tree	750	519	450	200	558	495
NI/tree	baht/tree	375	259	225	100	277	247

Table 3 shows that farmers who made higher initial and management investments gained much higher yields and higher net incomes per rai than farmers who invested less. For example, Farmer 3 invested 15,000 baht to plant 10 rai of jujube trees, expended 30,000 baht on management, and obtained a yield of 46,154 kg, which is the same yield obtained by Farmer 1 who had invested 28,000 baht to plant only 5 rai of jujube

trees and expended 60,000 baht on management. It appears that the relatively low investment by Farmer 3 resulted in lower productivity compared to other farmers. Therefore, a farmer who intends to start jujube production must be able to make a significant capital investment in order to establish a successful orchard. Farmers also need to somehow acquire the specialized skills and knowledge needed to manage jujube production.

The Agroecological Niche of Jujube in Ban Meng Sub-district

Although jujube is a much more profitable crop than cassava or sugarcane in upland fields in Ban Meng, only a handful of farmers have adopted this crop during the 12 years since it was first introduced into the sub-district. This reflects the fact that jujube occupies a rather narrow agroecological niche so it is only a suitable crop for farms that can meet all of the conditions needed to produce it successfully. In this section we describe the agroecological niche of jujube and compare it to the niches of cassava and sugarcane.

The niche concept, which as long been a key concept in natural ecology, refers to all the necessary environmental conditions for the survival of a specific species in a unique ecological community (Chase and Leibold 2003, Hutchinson 1957). The ecological niche concept was first extended to agricultural crops by Rerkasem and Rerkasem (1984) in a study of the agroecological niches of different varieties of rice in the Chiang Mai valley, Thailand. They found that farmers selected rice varieties according to how well they matched the specific environmental and economic conditions of their farms and the needs of their households. Selection criteria included farm size, cropping pattern, water conditions, market access, labor requirement, and eating quality. The agroecological niche of jujube can be analyzed in terms of nine main dimensions:

1. Soil fertility: Jujube tolerates many types of soils, but prefers sandy and well-drained soils and does not grow well on heavy and poorly drained soil. It is able to grow in soils with high salinity or high alkalinity. Thus, the soil in Northeast Thailand is considered a good area for jujube production.

2. Water supply: Although jujube trees are drought tolerant, regular and sufficient watering is important if they are to fruit heavily.

3. Initial capital investment: Jujube requires a higher capital investment than other crops.

4. Secure long-term land tenure: Jujube is a perennial crop requiring very high initial investment so that the farmers need to have secure long term tenure of their land.

5. Production Inputs:

- a) Labor: Jujube production has a high labor demand during the harvesting period. Half of the production cost goes to labor.

- b) Fertilizer/hormones: Regular application of fertilizers and hormones is essential to keep a high productivity.

- c) Pesticides: Applying pesticides is essential to protect the trees from diseases and insects.

6. Management requirements: Jujube trees require intensive management (spraying of pesticides, hormones and foliar fertilizers, pruning) for about 6 months of the year.

7. Need for specialized skill and knowledge: Farmers need to acquire specialized knowledge about management of jujube and learn new skills to successfully cultivate this crop. Most farmers gain this new knowledge from other farmers in the village.

8. Risk of pest damage: Jujube trees are vulnerable to diseases and insects with a high risk of production loss.

9. Toxic chemical risk: The high rates of chemical pesticide use are believed to be hazardous to farmers' health. Pesticide residues may also pose a risk to consumers but that is a less important consideration in farmer decision-making.

A comparison of the agroecological niches of jujube, cassava and sugarcane in Ban Meng sub-district is presented in **Table 4** and **Figure 4**.

Table 4 Comparison of the agroecological niches of jujube, cassava and sugarcane

Niche dimension	Jujube	Cassava	Sugarcane
Soil fertility	Low	Low ¹	High ¹
Water requirement	High	Low	Low
Initial investment	Very high	Low ²	Moderate ³
Need for secure long-term tenure	Very high (many years)	Low (1 year)	Moderate (1-3 years)
Production inputs			
• Labor	Very high (24 days/rai)	Low (11 days/rai) ¹	Moderate (16 days/rai) ¹
• Fertilizer	Very high	Low	Moderate
• Pesticide	Very high	Low	Low
Need for continuous management	High	Low	Moderate
Need for specialized skills and knowledge	High	Low	Moderate
Risk of pest damage	High	Low	Low
Risk to farmers from application of toxic chemicals	High	Low	Low

Sources: 1: Bernaud 2005; 2: Ubukata et al. 1998; 3: SoratPraweenwongwuthi, pers. comm., 24 January 2010

It can be seen from **Figure 4** that the niche space occupied by jujube is much narrower than those of cassava and sugarcane. This suggests that the potential for expansion of jujube production

is relatively limited. Only the small number of farmers who can meet all of its requirements will be able to grow this fruit successfully.

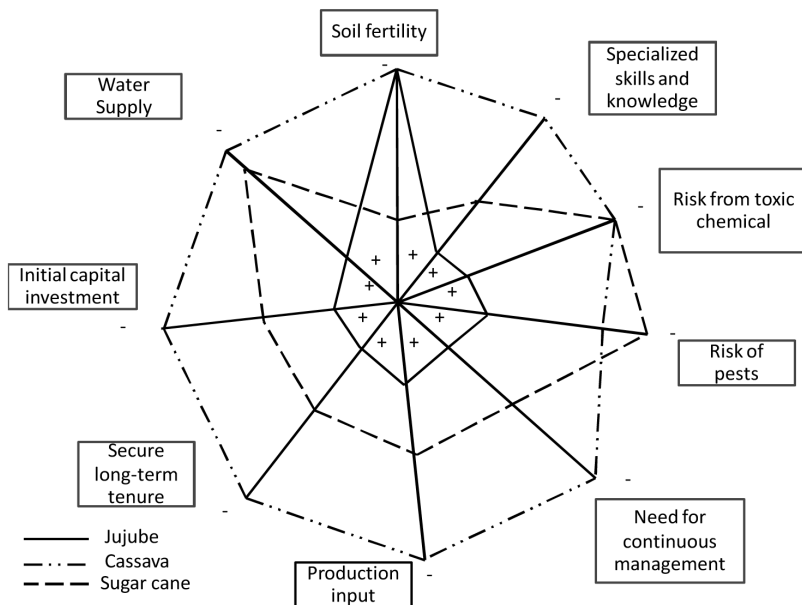


Figure 4 Comparison of the niche spaces occupied by jujube, cassava and sugarcane

Conclusions

Jujube production offers a new opportunity for small farmers in Northeast Thailand to generate high incomes from their land. However, in order to take advantage of this opportunity, farmers must make a very substantial initial investment in preparing and planting the orchards and installing irrigation systems. Farmers need to learn and use specialized skills to maintain high productivity. Farmers must control pests and diseases by heavily relying on chemical inputs that are a major health concern for them. The high management costs and intensive labor requirements can also be discouraging factors for farmers. Because the agroecological niche for jujube is much narrower than that of the upland cash crops like sugarcane and cassava, only a few farmers who can afford to make the capital investments for establishing the jujube farm as well as have access to production skill and knowledge will find that jujube is a suitable crop for production in Northeast Thailand.

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