

Analysis of Labor for Mechanized Working on Paddy Field

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Since 1969, the author has made research upon mechanized working on paddy field. Generally speaking, mechanization of agriculture has increased the productivity per worker and changed the character of farm work.

To increase the productivity per worker is directly related to working hours and field efficiency of using some machines. And to change the character of farm work is to make it less arduous and more attractive.

Since the mechanized working worker on the paddy field is under the influence of working conditions for his labor, the agricultural engineer should conduct research on mechanized

working on the paddy field. This study makes it clear that the work load and working hours of the worker per day are connected to the various conditions of the work.

Results and Discussion

For the analysis of labor for mechanized working on the paddy field, it is important to know RMR (relative metabolic rate) of each unit work and data of time-studies. Moreover, we have to know the energy expenditure in duty hours and field efficiency.

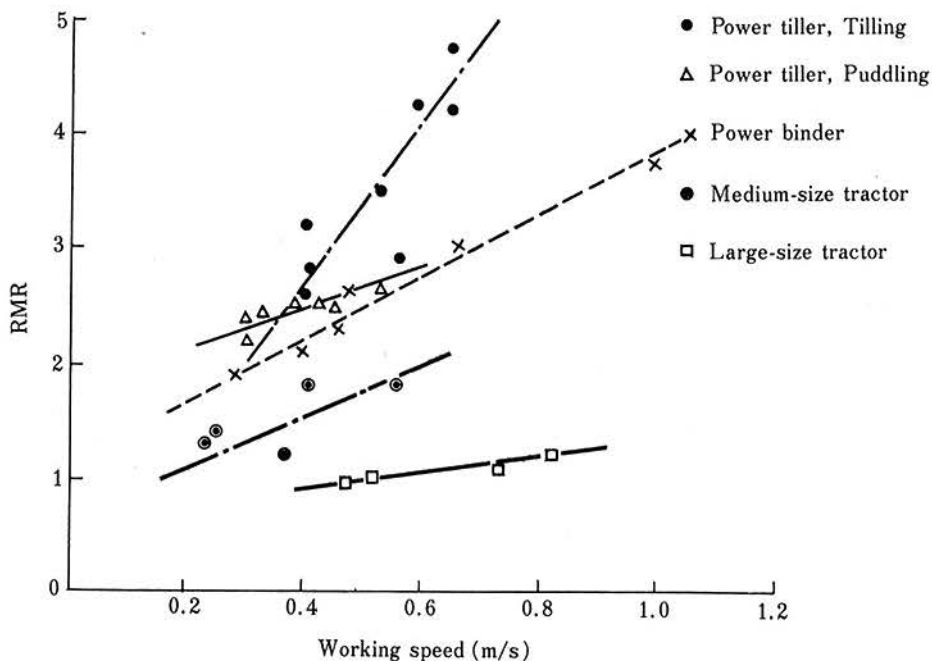


Fig. 1. Effect of working speeds on the value of RMR

1) *RMR of workers for several tasks using some machines*

From RMR surveys of farm workers using farm machines on paddy field, the results are shown in Table 1 and Fig. 1.

RMR of using power rotary tillers was 2.6–5.2 for tilling, and 1.9–3.8 for puddling. RMR of using wheel-type tractors was 1.0–1.8, of using rice transplanters (by human power) 3.4–4.6, of using cultivating implements

Table 1. RMR of worker for several works on paddy field

Operation	Working tool or machine	Working conditions	RMR
Tilling	Power rotary tiller with steel-lugged wheel and spading tine	Tilling width: 60 cm Tilling depth: 10.8–10.9 cm Working speeds: 0.39–0.45 m/s	4.2–5.2
Tilling	Power rotary tiller with rubber-tired and spading tine	Tilling width: 60 cm Tilling depth: 10.2–11.0 cm Working speeds: 0.36–0.65 m/s	2.6–4.7
Tilling	Medium-size, wheel-type tractor with rotary	Tilling width: 130 cm Tilling depth: 12.0–12.1 cm Working speeds: 0.25–0.37 m/s	1.2–1.8
Tilling	Large-size, wheel-type tractor with rotary	Tilling width: 100 cm Tilling depth: 12.0–13.4 cm Working speeds: 0.50–0.82 m/s	1.0–1.2
Puddling	Medium-size, wheel-type tractor with rotary	Puddling width: 130 cm Puddling depth: 15.3–15.4 cm Working speeds: 0.24–0.41 m/s	1.3–1.8
Puddling	Large-size, wheel-type tractor with rotary	Puddling width: 100 cm Puddling depth: 16.2 cm Working speeds: 0.48–0.73 m/s	1.0–1.1
Puddling	Power rotary tiller with steel-lugged wheel and spading tine	Puddling width: 60 cm Puddling depth: 11.2–14.2 cm Working speeds: 0.29–1.00 m/s	1.9–3.8
Rice planting	One-row type transplanter for manual	Working speeds: 0.34–0.44 m/s	3.4–4.6
Dusting	Knapsack power duster weights 10.5–13.5 kg	Dusting width: 3.0–3.3 m Working speeds: 0.44–0.58 m/s	3.4
Cultivating	Cultivating implement	Working speeds: 0.86–0.89 m/s	5.1–5.2
Binder	Two-row type, power binder	Working speeds: 0.31–0.52 m/s	2.2–2.6
Transportation	Power tiller	Transportation speeds: 0.54–1.48 m/s	1.6–2.2
Transportation	Power binder	Transportation speeds: 0.58–1.6 m/s	1.6–2.3
Transportation	Large-type tractor	Transportation speeds: 1.8–4.7 m/s	0.9–2.0

Table 2. Working hours and energy expenditure for tilling or puddling work at plain field

	Power rotary tiller		Wheel-type tractor	
	Tilling	Puddling	Tilling	Puddling
Duty hours per day (min.)	635.9	698.7	725.0	778.0
Working hours per day (min.)	528.6	589.2	629.6	696.7
Duty hours per 10a (min.)	132.3	182.2	63.5	121.3
Working hours per 10a (min.)	119.1	136.8	55.1	91.2
Energy expenditure per day (cal.)	2,647.6	2,952.5	2,368.7	3,078.5
Energy expenditure per 10a (cal.)	596.3	499.6	206.7	192.4
Average RMR	2.91	2.97	2.02	2.71

5.1-5.2, and of using power binders 2.2-2.6.

The value of RMR of using tractors ranges from 1.0 to 1.8, which were considered to have relation with the seating arrangement, controls of tractor and working speeds.

Generally, it is considered that the RMR value when using farm machinery has to do with working speeds and the various conditions of field surfaces. The technical innovation in recent years has had important effects, causing remarkable decrease in RMR of workers.

2) *The effect of the location and feature of field on the working efficiency of using power tiller*

From the results of time-study of works using power tiller for tilling and puddling, the effect of the location and feature of the field on the working efficiency is considered as follows;

a) Natural features were divided into three main parts: plain, foot, mount. On three parts, each total time of tilling work per day is equally 650.4 min., but the time of main work (to till a field) and annexed work (to move from field to field) is different among three parts.

b) The each rate of main work for total time is 60.5% (plain), 59.7% (foot), 45.5% (mount). It is observed that tilling work is more efficient on plain than on foot or mount.

c) From such a result, it is considered to be given a coefficient of field and a coefficient of natural features. It is sure that they are useful for making a plan of work using machines.

3) *Energy requirements for tilling and puddling*

The values of daily energy expenditure of farm workers are obtained by calculations on the basis of RMR and the data of time-study of farm work on paddy field. Results of calculations can be summarized as follows;

Topographical conditions of the field and the quality of operation will act upon the energy expenditure very strongly.

The energy expenditure per 10a for tilling work by power rotary tiller was 596.3 cal at plain field, 658.9 cal at foot field, and 879.0 cal at mount field, respectively.

The energy expenditure per 10a for puddling work by power rotary tiller was 499.6 cal at plain field, 646.6 cal at foot field, and 654.0 cal at mount field.

The energy expenditure per 10a for tilling work at foot field by large-size tractor with rotary was 264.4 cal, and by medium-size tractor was 333.4 cal.

The energy expenditure per 10a for puddling work at plain field by large-size tractor with rotary (3 workers) was 198.0 cal, and by medium-size tractor (2 workers) was 186.8 cal.

References

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