

FODDER CROP PRODUCTION FOR CONSERVATION AS WINTER FEED AND TECHNOLOGY TRANSFER FROM PAKISTAN TO N.W. CHINA AND NORTH VIETNAM

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A-CHINA

1. INTRODUCTION

Livestock production by transhumance rearing systems is the major land use and a source of livelihood in most areas of the arid, semiarid, and arid temperate agro-ecological zones of Asia. It is perhaps the best way of exploiting these pastures economically. Lack of feed is the major constraint to improving livestock production during winter and early spring, as the temperatures are extremely low during which the pregnant breeding stock is very vulnerable. For the last ten years, the Altay prefecture in China has undertaken an ambitious and impressive development plan to enhance and conserve alfalfa fodder by cultivating 20,000 ha of irrigated land for hay. At the same time it maintained transhumance of the herds through providing settled bases with education and social facilities for herder's households.

Land holdings of the farming communities in North Vietnam are extremely small. Therefore, intensive cultivation with triple cropping is common in the south while double cropping of rice is practiced followed by maize or vegetables in the North. In the rainfed hilly areas, cassava, sugar cane, and maize occupy most of the area.

Rice straw and maize stalks form the bulk of livestock feed during winter. These are usually supplemented by grass harvested from roadsides, ponds, and fields. Leaves and branches of trees are also fed to the livestock. Under the present situation insufficient fodder with poor quality is available in the area and hence the animals are underfed.

2. PRESENT GRAZING SYSTEMS IN CHINA

Kazak borders follow a traditional transhumance system: the herds graze during late spring, summer, and early autumn on mountain pastures and are herded down to the desert steppe when the mountains are covered by snow and temperatures are extremely low-even on the plains winter temperatures might fall to -40°C . The grazing system is a classical montane one, depending on the four main pastoral zones:

- A zone of alpine snow (the snow line is at about 3500 m) and rock, above the summer pastures, is of little use for grazing.
- Summer grazing lands, above 1300 m, provide rich grazing for 75 to 95 days per year. These are the fattening pastures and, in season, are generally in good condition and are probably capable of carrying more stock.
- Spring and autumn pastures are the transition routes, which are heavily grazed twice yearly, largely owing to a lack of winter-feed. Herds linger long on these pastures in autumn and go on to them too early in spring. The fodder production sites are all within the drier, southern fringe of this zone.
- Winter pastures consist of desert plains, low meadows and marshland, which are totally inadequate for the number of stock carried. For this reason the provision of conserved winter feed through irrigated hay production was identified as the most effective way of improving the overall animal production system and of reducing pressure on the winter and transitional pastures. During winter, the

stock grazes in the lowest areas of this zone along drainage lines and in river valleys. Desert pasture is only grazed when there is snow for drinking needs; a sudden thaw or deep snow would be disastrous.

The transhumance route is long, 180 to 200 km, from the desert plains to the heights of the Altay Mountain range. The approximate grazing periods are; spring (early April to end of June), about 90 days; summer (end of June to late September), about 83 days, autumn (mid-September to end of November), about 121 days. The people live in yurts (circular tents made of either felt or leather) during transhumance and, until the present development, overwintered in them.

Cattle, sheep, goats, horses and camels are all raised in the production system, sheep being the most important and cattle a close second. Altay Fat Rump, the main sheep breed, is a meat type famous for its fast lamb production. It can store 15 to 20 kg of fat in its rump and thus withstand the harsh winters.

For about 20 years, a crossbreeding programme, largely with Xingjiang Brown and Simmenthal, has upgraded a large part of the original cattle population while maintaining their hardiness. Milk production of the local breed is low. Medium-sized horses (350 to 400 kg) which are hardy and of good appearance are bred for sale, transport, meat and milk, which is an important summer food. The local black goat produces high-quality cashmere. Bactrian camels are used as saddle and pack animals and yield high-quality wool.

3. PROJECT AREA

The altitude ranges from 480 (at Fuhai) to over 3500 masl. The climate is markedly continental with hot summer and severe winters. The higher altitudes are much colder so the high pastures are open for less than three months a year.

There is some irrigated crop production of recent origin on the better soil. The snow-fed Ulungur and Irtysh Rivers provide a plentiful supply of good water, with a peak from snow melt in June, but soils available for fodder production are totally unsuited to continuous arable cropping. All fodder sites are below 800 m and their soils are poor, stony and shallow, sometimes with a thin cover of wind-drifted sand. They have a high pH and a tendency to salinity; they vary in depth between 10 and 50 m and are highly permeable. However, they are underlain by impermeable mudstone, which makes vertical drainage difficult.

4. PROBLEM IDENTIFICATION

With a development objective to enhance the income and improve living conditions of nomadic herders through increased forage production and settlement, at the same time retaining the transhumant system of grazing. The immediate objectives are: "to produce, through the irrigation by gravity of 34 425 ha of land, large quantities of hay, expected to reach 130 000 tonnes per year at full development (year 10).

5. ACHIEVEMENTS

It has provided an irrigated alfalfa farming regime for 6 100 Kazakh householders and income for more than 32 000 Kazakh people. This is more than 15 percent of the Kazakhs who live in the Altay Prefecture. Each family was allocated the responsibility for about 4 ha of irrigable land. A basic house was provided under a soft loan as winter quarters for the family and for those who remained on the plains for haymaking in summer. As they have gained profit from the enhanced fodder supply, most families have built courtyards, byres and ancillary buildings around the base unit. The average per capita income already exceeds 500 yuan per year which is 35 percent higher than that of those still

practicing the full nomadic'(transhumance) system. They also have access to schooling and better health care.

Thirty-two thousand ha have been developed, providing 20 000 ha of alfalfa pasture. The remainder is used for trees, roads, irrigation channels, buildings and drains. The average farm size is 3.68 to 4.30 ha, producing annually about 18 000 kg of hay from 3 ha. The remaining land is utilized for wheat, beet "or sunflower. At a feeding rate of 4 kg of hay per day (daily sheep requirement), the total hay supply will provide 4 500 feed days. Natural pasture provides a similar feed supply, so that each farm can produce 9 000 feed days or enough feed to winter 60 sheep equivalents for the 150 days of housing/natural pasturing. This equates to two to three cows per household plus 50 sheep.

6. DEVELOPMENT OF FODDER TECHNOLOGY

Lucerne is the only fodder grown commercially; until recently the local northern Xingjiang Beijing variety was the only one used. Some southern Xinjiang broad-leaved Laojiang and a selection by I College of Ximu (*M. media*) have also been used on a field scale. The dangers of establishing such a large project on a narrow genetic base are well recognized. An international collection of varieties, based on their reputed cold-resistance, were tested. None survived their first Xingjiang winter, which is generally snow-free on the irrigated plains. The accent, therefore, has to be put on selection within north China ecotypes. The northern Xinjiang landrace has small leaves, variegated flowers and withstands grazing well. It may be a hybrid with *M. falcata*, which occurs wild in the hills. The only other fodder still under trial is lotus, which shows considerable promise at Altay for poor and poorly drained land.

Table 1. Hay yields in demonstration areas

Site	Area (ha)	Tonnes/ha	
		1989	1990
Altai	56.7	6.45	8.25
Burjin Fuhai	112.4 70.2	5.50 4.90	7.90 7.20
Dure	62.3	3.21	7.20

Three main methods have been used: aerial seeding at burjin; direct seeding at Burjin, Fuyun/Dure (earlier years); and under sowing in wheat grown by local farmers at Fuhai and Altay. Direct seeding generally gave the best results by far (using 15 kg/ha of unscarified seed); land leveling irregularities have masked any differences between drilling and aerial sowing. Economic necessity coupled to problems of late spring wind damage to seedlings, led to under-sowing; carefully executed under-sowing gives reasonable stands. Under sowing lucerne to wheat is usually done by drilling them together while, with other row crops, lucerne is broadcast after weeding.

Two hay cuts are taken, in June and August, while the herds are in the mountains; the aftermath is usually grazed off in late autumn, stored in low, loosely compacted stacks in walled compounds; high stacks would be blown away. Skill in handling and curing hay was developed rapidly in the early years.

7. CROP ROTATIONS

Good crops of Lucerne (*Medicago sativa*) grow for at least four years if reasonably managed and maintained. Thereafter, one cereal or cash crop is taken before re-sowing to lucerne, generally

under a nurse crop (wheat, sunflower or beet). This system is popular, as it provides rapid cash. Farming standards vary widely, so extension and training of the herder-settlers are very necessary. Management rotations are being developed for alfalfa pastures, embracing four years of hay cropping after sowing, followed by ploughing, and then to wheat in the fifth year, followed by a second crop of variable choice in the sixth year before reverting back to alfalfa, either sown pure at 10 to 12 kg of seed/ha or undersown to wheat at a similar or slightly reduced rate. In any one year therefore, one-sixth of the projected area in alfalfa (20 000 ha) will require sowing. At a sowing rate of 12 kg of seed/ha, the total seed requirement will be 40 000 kg. The area of second-year alfalfa required to produce this amount is 140 ha. If a safety margin of 40 percent is allowed for crop failure, disease or poor weather at harvest, the total area required could be about 200 ha.

8. LIVESTOCK AND GRAZING MANAGEMENT

The winter pastures were the weakest part of the transhumance system and they have long been overgrazed. Project stock will use them less and less so, in principle, there should be a reduction of pressure on them, leaving more grazing available for the majority of other herds. These lands have little potential for improvement other than by good management and resting; the rainfall is too low to allow reliable reseeding. The spring and autumn pastures, as in all transhumance systems, get very heavy use. They are grazed immediately after the start of growth when the herds leave their winter pastures in spring and are again heavily grazed in autumn immediately before growth ceases. Because of the scarcity of winter feed, there was a tendency to linger on these pastures in autumn and let the herds on to them too early in spring. With the project's provision of better winter feed, there is now no reason for out-of-season use of these lands and it is hoped that the project flocks, being better fed, can cross them in a shorter period of time.

Table 2. Increases in crop yield (kg/ha) after lucerne in Fuhai

Crop	Before lucerne	After 4 years of lucerne
Wheat	2250	4500
Sunflower	1050	2050
Beet	22500	33750

In order to increase productivity, make better use of available fodder and minimize strain on the spring and autumn pastures, certain changes are being introduced in the animal production system. These include early lambing in February, instead of April, which should produce stronger lambs that will cross the transition pastures more quickly as well as heavier lambs, with an additional 7 to 10 kg of live weight (the traditional weight is 30 to 35 kg), for slaughter in September. Moreover, about 80 percent of the ewe lambs may be mated in the first season. Throughout the Altay Prefecture, 50 000 ewes have lambs early, 2800 in the project area, for which good winter-feeding and some shelter are necessary. Slaughtering lambs for freezing in September, rather than overwintering them for summer fattening, has been the policy since the early 1980s.

9. PRESENT CROPPING PATTERNS IN CHINA

- Alfalfa, maize, wheat sunflower, and grasses are the major crops in Xinjiang. Maize and wheat are grown as dual-purpose crops i.e. grain for human and straw for animal feed. Due to small- medium land holdings, farmers can not afford to keep the land fallow.
- Also some areas are planted under melons and vegetables such as potatoes, tomatoes, beans, etc.
- At least 50 % area of the total farm is planted under alfalfa that helps in improving soil fertility and organic matter.
- All the alfalfa fields had been badly and heavily infested with dodder. Therefore, yields, are very low and quality of seed produced is very poor.

10. SUGGESTED CROPPING PATTERNS IN CHINA

As mentioned earlier due to limited irrigation facilities and shortage of quality winter fodder, the farmers plant almost 50% of the land with local alfalfa and 50% of the area is cultivated with cereal crops like maize, wheat, and sunflower. After reviewing the present cropping patterns and assessing the prevailing fodder situation in the area especially the degree to which a shortage of winter fodder limits animal production in the region, and based on field visits following changes are suggested in terms of cropping practice and specifically in terms of few fodder crops which might result in increased availability of quality fodder for livestock especially during the winter period.

- New crops such as dodder free improved alfalfa (*Medicago sativa*), bersccm (*Trifolium alexandricum*), multicut oats (*Avena sativa*), pearl millet (*Panicum typhoides*), cowpeas, mungbeans, sorghum, sudan grass hybrid etc. established in pure stands as well as inter-cropped should be evaluated in the area.
- Under the present cropping patterns of dodder infested alfalfa fields, maize, sunflower, and wheat apart from poor soil fertility, severe attack of disease might result in total crop failure. Therefore, the rotations like oats / ryegrass + alfalfa, oats / ryegrass + redclover, oats + bersccm, oats + vetch, millet/maize + cowpeas etc. should be adapted and encouraged.
- In the areas with fodder tree plantations, inter-cropping of berseem, alfalfa, and red clover with oats / rye grass should be investigated.
- Introduce and evaluate several winter active and moderately winter dormant lucerne varieties in different agro - ecological zones throughout the region.
- Although farmers cultivate local land races of maize, wheat, and sunflower as sole crops but yields of local land races are very low. Therefore, it will be better to introduce hybrid maize/ sunflower and improved wheat varieties much better in grain and stover yield than the local varieties.
- In rain fed areas, introduce drought tolerant crops such as sorghum, Sudan grass hybrids and pearl millet for maximum fodder production.
- As the climatic conditions are very suitable for cultivation of temperate fruit species, it would be a welcome addition to introduce cherry, apple, apricot, grapes, almond, walnuts fruit orchards in the huge alfalfa fields. It would definitely improve nutrition and income of the poor communities without effecting alfalfa production.

11. LOCAL ECOTYPES COMPARED TO IMPORTED VARIETIES

In addition to local ecotypes and varieties, there are a number of varieties available from other countries that have proven to be very productive to farmers through out the world and especially in the Northern Areas of Pakistan. This could also be true for Xinjiang, China.

In general, the non-dormant (ND) and very non-dormant alfalfa cultivars (VND) will be adapted to all but the colder areas of the Altay Prefecture. The intermediate dormant (ID) and moderately non-dormant (MND) varieties can also be grown successfully in all areas of Xinjiang, but they are particularly adapted to areas with colder winters where temperatures from -10°C - 0°C occurs at night for extended periods during the winter. ND and VND varieties can also tolerate similar temperatures for very short periods of time without killing the plant, but destroying the above ground forage.

Initial yields trial comparing local ecotypes with introduced alfalfa varieties should be conducted in Altay Prefecture to select suitable varieties for a particular area. Without the comparison of local ecotypes and varieties with introduced varieties, it is impossible to intelligently choose the proper variety for different locations within individual Countries. A high priority should be given to Xinjiang for establishing relationships with all the alfalfa producing countries. The seed production can be developed on commercial basis at sufficiently large scale to satisfy the total demand with in each Country or contracts made with seed producers in other Countries who can supply large amounts of high quality seed of the appropriate, tested varieties.

12. TRIALS PLANTED DURING SPRING 2000 AND POTENTIAL FORAGE CROPS

One trial was planted with six winter dormant/winter active varieties of alfalfa, three varieties of oats, two sunflower and one each of sorghum-sudangrass hybrid, rye grass, Egyptian clover, and vetch as inter-crop as well as sole crops. Also applied 200 kgs. Nitrophos + 100 kg. Urea at sowing time. 100 kg. Urea should be applied after every harvest to sorghum, oats, rye grass, and brassica. The following data should be recorded at harvesting time.

1. Plant height of 5 random plants. 2. Number of tillers per plant. 3. Number of cuttings obtained, 4. Green fodder yield (tons/ha), 5. Sun dry weight/yield (toncs/ha).

- Harvest oats & sorghum at 25% flowering/heading
- Harvest rye grass when it is 3 feet tall.
- Harvest alfalfa, vetch, and brassica at 1/10 Th bloom stage.

The summary of potential forage crops for the region with necessary management practices is given in Appendix-1 and detail of trials planted is presented in Tables 3 & 4.

Table 3. Seeds introduced from Pakistan to Urumqi, China (Spring 2000)

Crop	Varieties	Quantity (Kg)	Area (ha)
Lucerne	08	40	8.00
Vetch	01	02	0.25
Brassica	02	02	0.25
Rye grass	01	02	0.10
S.S.Hybrids	01	04	0.30
Hybrid Sunflower	02	04	2.00
Egyptian Clover	01	04	0.25
Total	10	58	11.15

Table 4. Trials established at grassland institute, Altay Prefecture

Species	Sowing month
Oats + Lucerne	April, 2000
Rye grass + Lucerne	April, 2000
Lucerne varieties	April, 2000
Oats + Vetch	April, 2000
Oats Varieties	April, 2000
Hybrid sunflower	April, 2000
S.S. hybrid	April, 2000

B-NORTH VIETNAM

1. RUMINANT FEEDING SYSTEMS IN NORTH VIETNAM

Because of small land holdings and limited irrigation facilities, 95% of the crop production in North Vietnam depends on rain. In irrigated areas, majority of farmers plant rice, vegetables, and orchards. Some areas are cultivated with sugarcane, cassava, groundnut etc. Small areas are cultivated with grasses for livestock feed. During winter the livestock is offered small quantities of rice straw, limited maize stalks, and dry grasses.

The average farmer rears 1-2 cattle and 3-4 goats. Also the number of animals depends on farm size. The animals are mostly stall fed but also grazed on crop residues and field boundaries for part of the day. The animals manure is a major source of soil fertility.

The irrigated lands are not extensive enough for cash crops and orchards. Therefore, most of the farmers are unable to spare a sufficient piece of land for fodder production. The livestock faces severe nutritional deficits during winter. Some fodder crops like maize, panicum, etc are planted but not yet wide spread. For these reasons improved quality fodder is required for livestock and subsequently manure to improve soil fertility for better crop and fruit production.

2. PRESENT CROPPING PATTERNS

Rice, maize, Peanut, sweet potatoes and cassava are the main crops in North Vietnam. Limited land holdings dictate intensive farming system. Also moderate temperatures favour harvest of two rice and maize crops per unit area per year. On the other hand, the seed of local varieties used to produce crops is poor in genetic potential, hence the yields are very low. After the harvest of second rice or maize crops, part of area is planted with vegetables like sweet potatoes, tomatoes, onions, beans, etc. After second rice crop, 20% of the total area is planted under soybean that helps to replenish soil fertility and organic matter.

3. RECOMENDED CROPPING PATTERN

As mentioned earlier that limited land holdings demand for intensive agriculture practices with maximum cereal and vegetable production but minimum legume cultivation. In this way the soil fertility is decreasing and accordingly the yields would decline sharply with in 5 - 10 years. Therefore:

- Legumes like faba beans, cowpeas, mungbeans, vetch etc. should be intercropped with maize.
- 20 kgs/ha berseem (Egyptian clover) seed should be broad casted one to two months before harvest of rice. After rice harvest, it can be fed/grazed to livestock or green manured
- Lucerne, red clover and vetch should be inter-cropped in pure Guinea grass fields already established in rows at Goat and Rabbit Research Centre.
- Under the present cropping system of planting rice - rice and maize - maize, apart from depletion of soil fertility, severe attack of diseases might result in total crop failure. Therefore, the rotations like rice - legume - maize- vegetables - rice should be demonstrated to farmers for quick adaptation.
- In the areas around Bavi, intercropping of lucerne, vetch and red clover with cassava and perennial grasses should be investigated.
- Introduce and evaluate several winter active and winter dormant lucerne varieties in mountainous areas.

- Although farmers produce two maize crops per year but the local maize varieties are susceptible to diseases and yields very low. Therefore, it will be better to cultivate only one hybrid maize crop that is superior in grain and stover yield than the local variety.
- In rain fed areas, introduce sorghum sudan grass hybrids for maximum fodder production.
- Also fodder yields potential of oats/rye grass varieties as a sole crop and intercropped with vetch, forage peas and perennial peanut should be explored.

4. FORAGE CROPS/SPECIES INTRODUCED

Farmers in North Vietnam practice intensive agriculture through harvesting 2-3 cereal and 2 vegetable crops per unit area per year but it is not very rewarding and economical. On the other hand, due to poor genetic potential of seeds used and over utilization of land, the yields are very low. It will be better to have only one hybrid maize crop with almost 2-3 times higher yields instead of two poor maize crops with low yields. The farmers should utilize the land for growing legumes instead of second maize crop. Species of cereals and legumes introduced and planted for future evaluation in North Vietnam during December 2000 are presented in Table

4.1 Seed introduction

Following seeds of different forage crops/species were introduced and planted in North Vietnam for evaluation and selection of suitable varieties/species.

Table 5. Seeds introduced from Pakistan to Vietnam

CROP	Varieties	Quantity (kg)	Area (ha)
Lucerne	08	8.00	2.00
Red Clover	01	2.00	0.50
Vetch	01	12.00	0.30
Oats	04	13.00	0.20
Rye grass	01	1.00	0.10
S.S.Hybrids	01	1.60	0.10
Hybrid Maize	01	3.00	0.20
Perennial peanut	01	2.40	0.30
Total	18	43.00	3.70

5. REFERENCES

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